Proceedings Issue

SCIENCE

21 February 1958

Volume 127, Number 3295

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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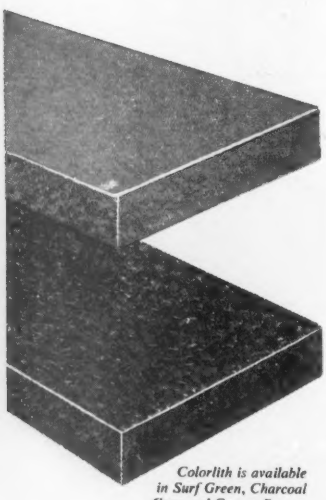

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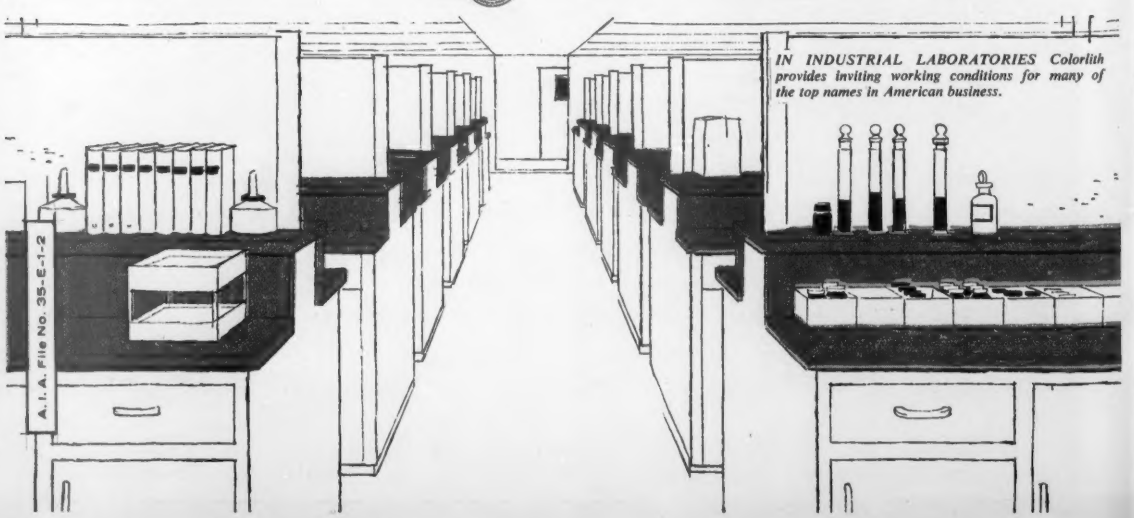

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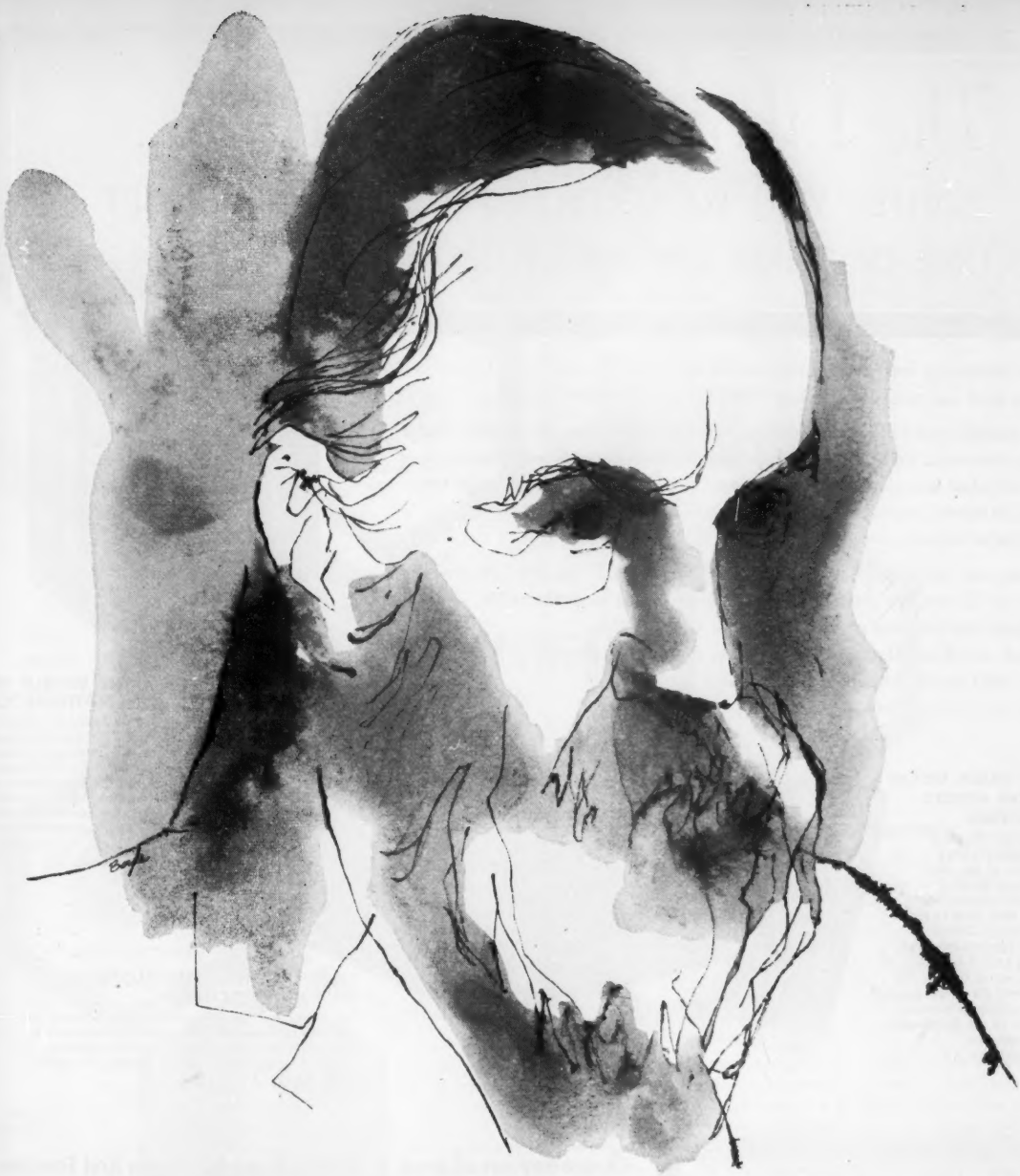

Ernst Mach...on absolutes

"No one is competent to assert things about absolute space and absolute motion; they are pure matters of thought that cannot be produced in experience. All our principles of mechanics, as we have shown in detail, are experienced knowledge concerning the relative positions and motions of bodies. They could not be, and were not, admitted in the areas in which they are now recognized as valid, without previous testing. No one is warranted in extending these principles beyond the boundaries of experience. In fact, such an extension is meaningless, as no one would possess the knowledge to make use of it."

—*Die Mechanik in ihrer Entwicklung*, 1912

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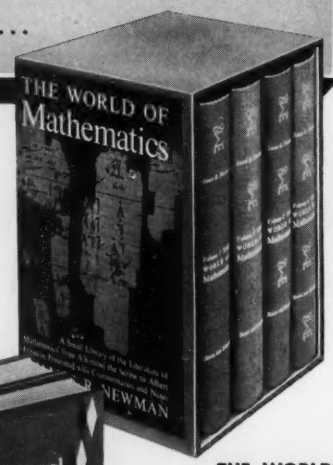

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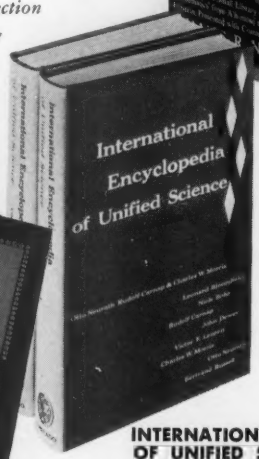

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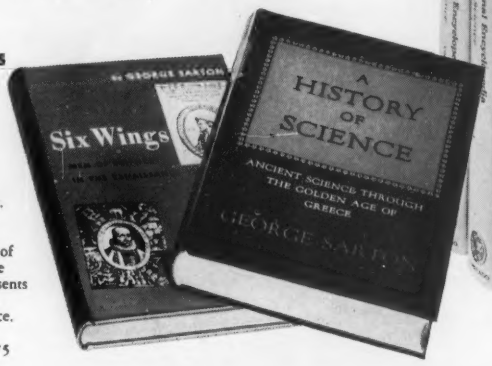

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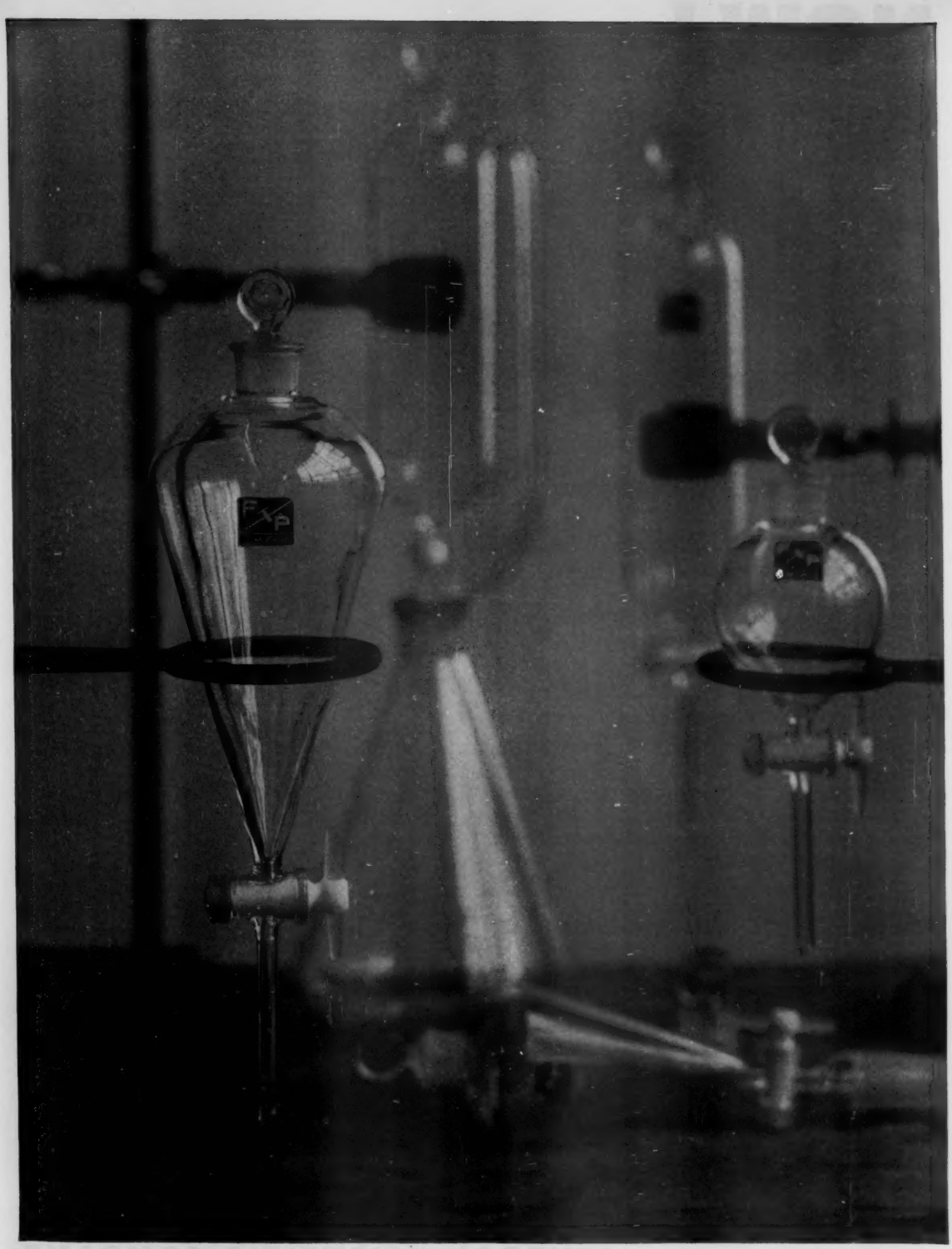

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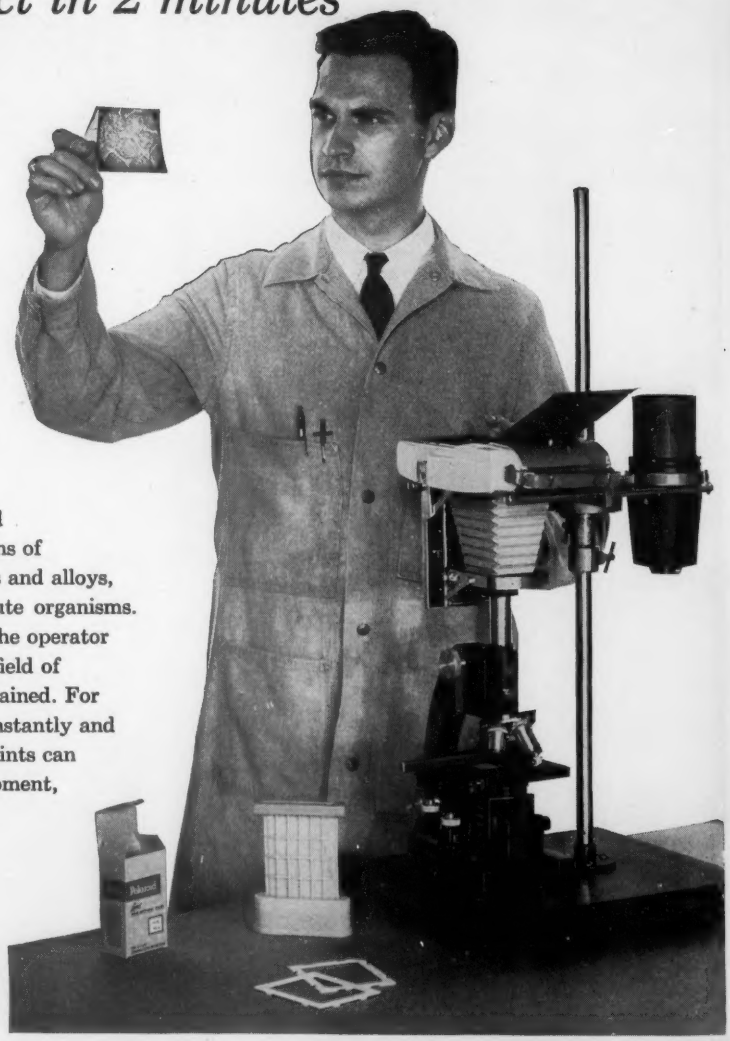

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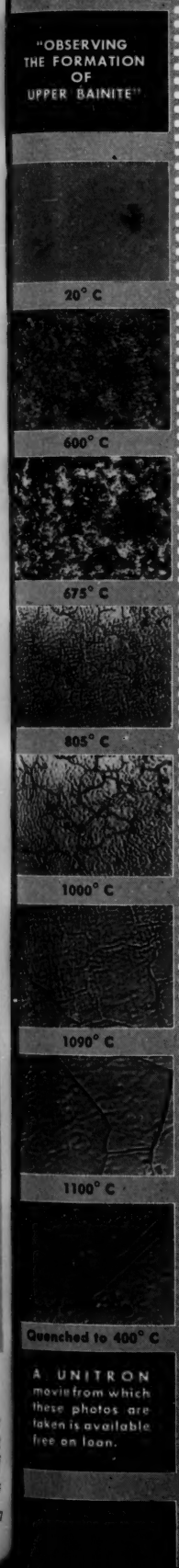

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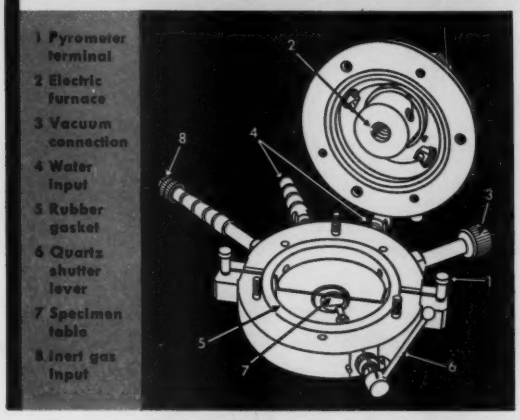

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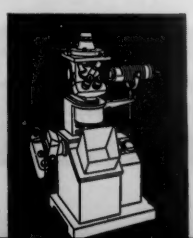

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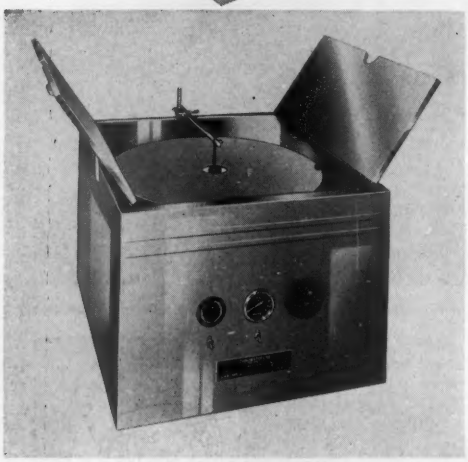

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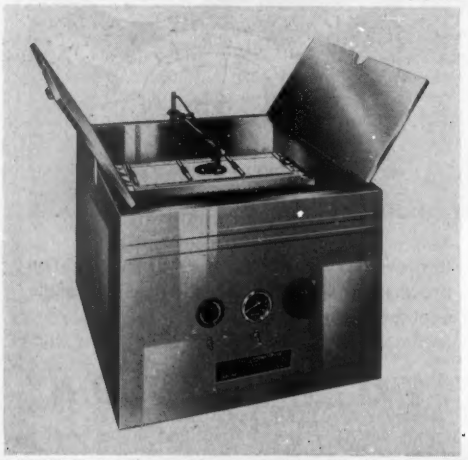

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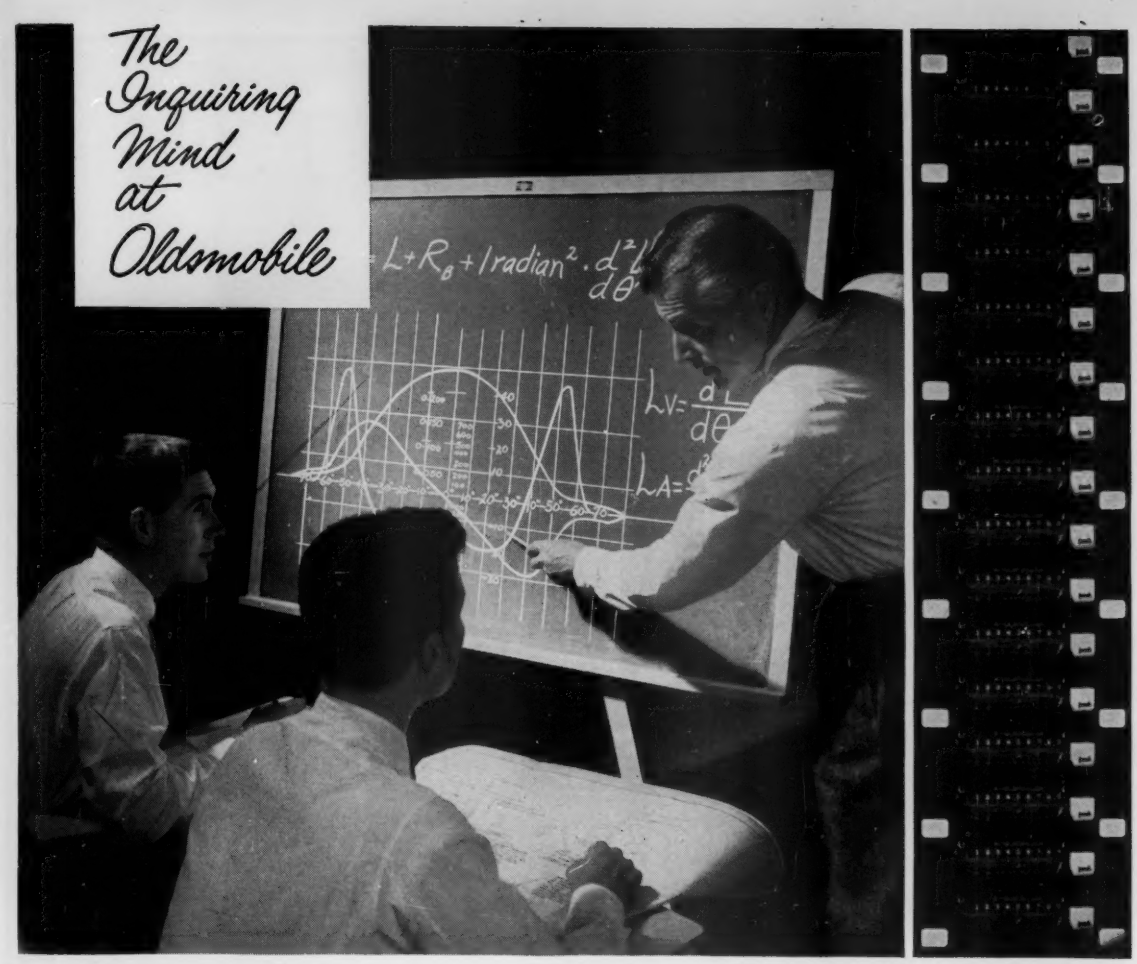

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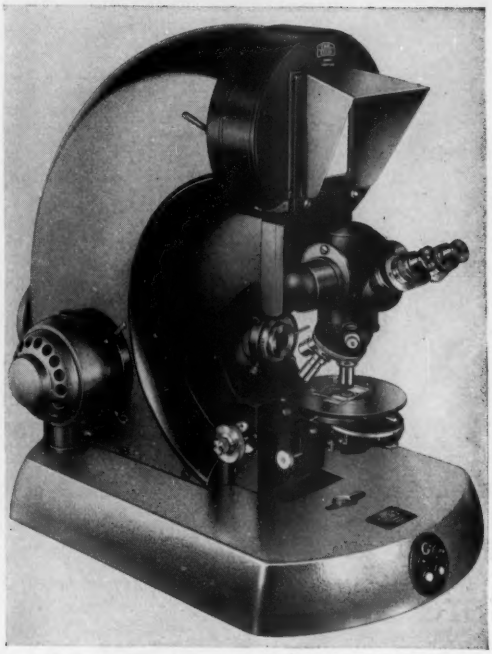

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Education and Strategy

Despite military attention to the importance of good training, despite the ROTC and other schemes of military and educational cooperation, despite growing national reliance on persons educated in science, language, management, and other specialized fields of knowledge; despite all these, the planning of the nation's educational activities and the planning of its national policies have gone their separate ways with only occasional points of contact.

Even now, although there is widespread attention to both educational needs and national policy, the two are frequently thought of separately, and when they are thought of together there is a tendency to confuse strategy with tactics. This confusion leads to overemphasis on short-term objectives and to the consideration of individual educational changes rather than an over-all program.

Yet the signs of more thoughtful planning are increasing, and a new partnership may be developing, one in which educational policies will become an integral part of national strategy. One sign is the widespread attention given to Paul Woodring's suggestions for a thorough replanning of elementary, secondary, and collegiate education [*A Fourth of a Nation* (McGraw-Hill, New York, 1957) and *Life* (2 Sept. 1957)]. Another is the sincere search by some Congressmen for basic educational issues and problems. That the cultural, economic, and scientific development of the future is being determined by what we do in the schools today has been said in many ways by many people.

Internationally, also, the relations between policy and education are gaining attention. In the current issue of *Foreign Affairs*, Lloyd V. Berkner argues that because military power has become absolute—one nation can annihilate another, or be annihilated—it has become of reduced effectiveness in international relationships and the winning of allies. Similarly, wealth is of lessened power in this regard. Intellectual preeminence, Berkner continues, is the new force that is replacing military strength and wealth. The implications for education and research, for cooperation with and technical aid to other nations, and for the prompt release of new scientific information are obvious. A negative example cited by Berkner is the failure of the United States to capitalize on the tremendous potentialities of opening the door to all peoples to come and learn and to cooperate in the development of peaceful applications of nuclear energy.

The problem of using education as a maximally constructive force in national and international policy (not just military policy), while at the same time preserving traditional values, poses an exciting challenge to political and educational statesmanship. Perennial problems for which we have yet to develop satisfactory policies are the questions of how to finance a vastly improved educational program and how to solve the nation-old riddle of federal versus state responsibility. Perhaps more important is to agree on a set of values and objectives that will give the whole educational venture the status it must have if it is to serve effectively in this larger role and that will accommodate our different but not necessarily conflicting values of aiding the handicapped, serving the average, and developing the superior student, each optimally in terms of his own capacities and potentialities.

A concerted attempt to solve these problems is an altogether seemly enterprise. In an intellectual race we can constructively compete with any other nation and can help to erect the highest kind of model for the aspiring eyes of less privileged nations. The goal is the positive one of developing to the fullest the intellectual resources of mankind.—D.W.

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Measurement and Man

S. S. Stevens

In some parts of science we have reduced the business of measuring to simple routines, chores to be done by technicians—animate or inanimate. In these areas the basic and challenging problems of measurement have been solved, and the only task left is to implement, read, and record. In other parts of the discipline the problem of how and what to measure remains acute and real. The task is not simply to read a meter or gauge an effect; it is to devise a procedure by which to quantify some stubborn phenomenon—to reduce it to numerical order.

Much that pertains to man himself poses knotty problems of just this sort. How shall we measure his capacities, his attitudes, his sensations, or any of the many aspects of man that cannot be weighed in a balance or marked off on a stick? Is measurement possible here, and if so, to what degree? But first of all, what precisely do we mean by measurement and what are the forms it may take?

Mathematics versus Measurement

"Probably more nonsense," said N. R. Campbell, "is talked about measurement than about any other part of physics" (*1*). Crotchety as this remark may sound, Campbell did not intend thereby to belittle the power and beauty of physical measurement or the superlative ingenuity of laboratory practice. But the art of measurement is one thing; the understanding of its fundamentals is another. And Campbell—the author of *Physics: the Elements*—was trying to teach us the same truth that Whitehead had in mind when he observed that "it is harder to discover the elements than to develop the science" (*2*). This is the way it has been with measurement. Here as elsewhere it has often taken our greatest minds to discover the simplest things.

One of these things is the relation between measurement and mathematics. It seems clear to us now that the process of measurement is the process of mapping empirical facts and relations into a formal model—a model borrowed from mathematics. But this conception took form only in very recent times. It is the product of long centuries of intellectual struggle, to which many of the foremost mathematicians contributed. It is a conception that was impossible, even unthinkable, until the nature of mathematics as a postulational system became clarified.

Once a basic and elementary notion dawns upon us in its full clarity, we often wonder how our fathers could have missed perceiving it. It is a curious fact that, although the postulational method was applied to geometry some two millenniums ago, only in modern times were the fundamental assumptions of algebra exhumed from the hodgepodge of rules that govern algebraic practice. In this sense, the modern postulates of algebra represent the distilled wisdom of more than 3000 years of symbol juggling. They represent the outcome of our efforts to pare away the nonessentials in order to get a clear view of what constitutes the essence of a mathematical system.

And the essence is this: mathematics is a game of signs and rules, man-made and arbitrary, like the game of chess. It begins with a set of undefined terms and a set of unproved assumptions regarding their interrelations. The mathematician invents symbols, and at the same time he lays down rules to tell us how these symbols shall be allowed to combine and interact. Nowhere in this process, as we now conceive it, is there any reference to empirical objects—or any explicit concern for the world of sense and matter. Therein lies the revolutionary novelty, for not long ago, as human history goes, it was argued that negative numbers were "absurd" and "fictitious." For how could anything be less than nothing? You see, our ancestors thought it proper to test their mathematics by operations performed upon nature—upon actual objects—for they conceived arithmetic as a system of concrete numerical magnitudes whose relations should be verifiable in the empirical domain, and where in the real world were the negative objects?

The story of the slow and painful growth of the number system, the story of how the mathematicians, often against their own better judgment, began to write outlandish symbols, such as -3 and $\sqrt{-1}$, is a fascinating tale. It could occupy us at length, but we must forego it. Its bearing on our present concern relates mainly to its outcome. With each new kind of number admitted to the number domain—the negatives, the irrationals, the imaginaries, and so on—it became more clearly impossible to prove arithmetic by appeal to experiment. So in the end the formal, syntactical system of mathematics achieved its full emancipation, its complete decoupling from empirical matters of fact. Thence it took off into the realm of pure abstraction, where it properly belonged in the first place.

Why did this decoupling take so long? Why so much travail to achieve something so simple and obvious? The difficulty, it seems, was measurement. In particular, it was the fact that the early mathematicians did not readily discern the difference between measurement and mathematics. Man was usually more interested in empirical measurement than in mathematics—as the scientist, no

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doubt, still is—and it was the problem of measurement that first gave rise to arithmetic. In the beginning, mathematics and measurement were so closely bound together that no one seemed to suspect that two quite different disciplines were involved. The earliest scales of measurement were scales of numerosity—scales for the counting of pebbles or cattle or warriors. In some dim era in the past, somebody invented the system of natural numbers precisely for the purpose of representing what he did with collections of objects. No doubt this forgotten genius was oblivious to the formal-empirical dichotomy, which we now consider so crucial. But that is beside the point. However he may have regarded it, the fact is that he built himself a formal model to stand for an aspect of the empirical world, much as an architect draws a plan for a house. Kronecker once said, "God created the whole numbers; all the others are the work of man." Passable theology, perhaps, but surely bad history.

Since arithmetic was invented for measurement, it is not surprising that the isomorphic correspondence between whole-number arithmetic and the empirical numerosity of piles of pebbles is tight and complete. It was, in fact, the very tightness of this isomorphism that blinded the ancients to the essential difference between mathematics and measurement. But modern mathematics is no longer constrained to serve only as a syntax for quantitative discourse. Far from limiting itself to serving as a model for numerosity, or even as a model for such continuous dimensions as length, it has become largely nonquantitative in some of its more abstract reaches. This outcome has suggested to Gödel a startling thought—namely, that is was purely an historical accident that mathematics developed along quantitative lines (*3*). In one sense Gödel is undoubtedly right, and his conjecture is a profound commentary on the nature of mathematics. But the story of measurement suggests that this "accident" had about it a certain inevitability. Striving somehow to count his possessions, ancient man seems destined in the nature of things to have hit upon the concept of number and to have made therein his first triumphant abstraction. Given the deeply human need to quantify, could mathematics really have begun elsewhere than in measurement?

It is not, however, only in history that we see the slow development of the formal-empirical dichotomy. An analogous development takes place in the lives of all of us. Just as ontogeny to some extent repeats phylogeny, so in the life of each maturing child the struggle of the ages is reenacted in the child's attempt to grasp the abstraction of mathematics. He learns his first arithmetic with the aid of fingers or buttons or beads, and only with great labor does he finally, if ever, achieve the reoriented view that mathematics is an abstract game having no necessary relation to solid objects. Each of us has suffered through this process of revision. Even though you may have shifted gears more smoothly than I, still you may well sympathize with my own dismay at my first encounter with imaginary numbers.

The Nature of a Scale

In its broadest sense, measurement is the business of pinning numbers on things. More specifically, it is the assignment of numbers to objects or events in accordance with a rule of some sort. This process turns out to be a fruitful enterprise only because some degree of isomorphism obtains between the empirical relations among the properties of objects or events, on the one hand, and some of the properties of the number system, on the other. Some of these properties, and their uses in measurement, are these: (i) Identity: numbers may serve as labels to identify items or classes. (ii) Order: numbers may serve to reflect the rank order of items. (iii) Intervals: numbers may serve to reflect differences among items. (iv) Ratios: numbers may serve to reflect ratios among items.

These are ways in which we may deputize numbers to represent one or another aspect of a state of affairs in nature. Depending upon what kinds of empirical operations we are able to perform, one or more of these aspects of the number system may be used as a model to represent the outcome. The empirical operations are sometimes a matter of choice; more often they are limited by our experimental ingenuity. In any case, the nature of the operations determines that there may eventuate one or another of four kinds of scales (*4, 5*). These I have called "nominal," "ordinal," "interval," and "ratio." They are listed and described in Table 1.

The key to the nature of these different scales rests with the concept of invariance. How can we transform the numbers on the scale with no loss of empirical information? If all we can do about a set of objects is identify or classify them, we have only a nominal scale, and the numbers we assign can be permuted at will, for all that the numbers provide are labels. If operations exist for determining order, and if we have assigned numbers to reflect this fact, then the permissible scale transformation must be order-preserving. When intervals have empirical meaning—as on the ordinary temperature scale—we are limited to linear transformations. We can multiply by a constant and add a constant. And finally, if in addition to all this we can give empirical meaning to ratios, the only permissible transformation is multiplication by a constant, as when we convert from feet to inches. Any more liberal transformation entails a loss of information. In general, the richer the experimental operations, the greater is the isomorphism between them and the formal model of arithmetic, and the more restricted is the range of invariant transformations. [For a possible fifth type of scale having a still different transformation group, see (*5*) and (*6*).]

Each of these scales has its uses, but it is the more powerful ratio scale that serves us best in the search for nature's regularities. On these ratio scales we measure basic things, like numerosity, length, and weight, and, depending on our artistry, we contrive more elusive measures, like the charge on the electron or the strength of a magnetic field.

Why, it may be asked, do we bother with the other types of scales? Mostly we use the weaker forms of measurement only *faute de mieux*. When stronger forms are discovered we are quick to seize them. But science is an art. There are no *ab initio* principles to tell us how to be clever in devising procedures of measurement. The way to empirical discovery lies not through mathematics, even, but through the exercise of uncommon experimental sense and ingenuity. We invent mathematical models, but we discover measures in the laboratory. As Norbert Wiener (*7*) said, "Things do not, in general, run around with their measures stamped on them like the capacity of a freight car; it requires a certain amount of investigation to discover what their measures are."

Perhaps those who stand apart from the practice of the scientific art, and who philosophize about the "scientific method," think there really is such a thing, and that it can be captured in a book of rules. But the man on the laboratory stool is likely to agree with Hildebrand that "there is no such thing as *the*

scientific method" (*8*). If you think science is a simple and unitary thing, try asking several scientists to define it. One of the entertaining things about science is that no one has succeeded in explaining precisely what it is.

However you define the scientific activity, measurement pervades most of the enterprise. Measurement is essential to the determination of functional relations, to the discovery of order and regularity. I need not extol it further, for we all know the reality of its power. In fact, we take it so much for granted that it becomes almost unthinkable that the pursuit of measurement did not always stand in high regard.

I vividly recall Professor Whitehead, peering over his lectern in Harvard's Emerson Hall and rasping out wisdom in his high-pitched voice: "If only the schoolmen of the Middle Ages had measured instead of classifying, how much they might have learned." Under the influence of Aristotelian logic, with its emphasis on classification, the schoolmen forsook the Pythagorean tradition, which taught the primacy of number and measurement. Classification, to be sure, is a first and essential step on the road up the hierarchy of scales. It gets us to the nominal level. But this is no more than a quarter-way house on the road to measurement in its more powerful forms. The revival of modern science in the 17th century—the century of genius—was a revival of the Pythagorean outlook, a revival of measurement. With Galileo, Newton, and the rest, science became primarily quantitative, and so it has remained.

In his diagnostic satire entitled *Science is a Sacred Cow,* Standen perceived correctly the modern order of things when he put measurement at the top of the scientist's totem pole [see (*9*)].

Measurement in Psychophysics

Measurement, as we have seen, is more than the pedantic pursuit of a decimal place. Its vital and absorbing aspect emerges most clearly perhaps when it becomes a question of measuring something that has never been measured. Or better still, something that has been held to be unmeasurable. Quantification is a respectable enterprise in physics and chemistry, and even in much of biology. But what about man, and the measurement of his higher processes? Are we always objective and emotionally neutral about this prospect?

The economist Edgeworth (*10*) once wrote, "There is an old prejudice still reviving, however often slain, against the reign of law in psychology, as incompatible with the higher feelings." Some there are, I suppose, who still feel that quantification, by some brutal rigor, will shatter the human spirit if we probe with the aid of numbers. But man can hardly fall in stature by understanding man, or even by quantifying that understanding. The greater beauty of discovered order will surely more than compensate for the nostalgic pain of a romantic yearning to remain securely inscrutable.

However we regard this issue, the fact remains that man is undergoing measurement. We are all familiar with the highly developed business of testing human performance and ability, and with the pioneering work of Binet, who launched us on the road to the measurement of the IQ. This measure, with its approximate invariance over the child's growing years, stands as one of the first-rate contributions to human understanding. Interesting issues for the theory of measurement arise almost daily in these burgeoning fields of ability assessment. But since this is not my own area of interest, let me turn to another quest: the measurement of sensation.

Modern experimental psychology had its beginnings in this inquiry, which started just about a hundred years ago—in the 1850's.

Let me pose the problem in this way. Suppose you look at a photograph in the bright sunlight and then again in a dimly lighted room. The remarkable fact is that the picture looks much the same

Table 1. A classification of scales of measurement. Measurement is the assignment of numbers to objects or events according to rule. The rules and the resulting kinds of scales are tabulated below. The basic operations needed to create a given scale are all those listed in the second column, down to and including the operation listed opposite the scale. The third column gives the mathematical transformations that leave the scale form invariant. Any number x on a scale can be replaced by another number x' where x' is the function of x listed in column 2. The fourth column lists, cumulatively downward, examples of statistics that show invariance under the transformations of column 3 (the mode, however, is invariant only for discrete variables).

Scale	Basic empirical operations	Mathematical group-structure	Permissible statistics (invariantive)	Typical examples
Nominal	Determination of equality	Permutation group $x' = f(x)$ where $f(x)$ means any one-to-one substitution	Number of cases Mode "Information" measures Contingency correlation	"Numbering" of football players Assignment of type or model numbers to classes
Ordinal	Determination of greater or less	Isotonic group $x' = f(x)$ where $f(x)$ means any increasing monotonic function	Median Percentiles Order correlation (type 0: interpreted as a test of order)	Hardness of minerals Grades of leather, lumber, wool, and so forth Intelligence-test raw scores
Interval	Determination of the equality of intervals or of differences	Linear or affine group $x' = ax + b$ $a > 0$	Mean Standard deviation Order correlation (type I: interpreted as r) Product moment (r)	Temperature (Fahrenheit and Celsius) Position on a line Calendar time Potential energy Intelligence-test "standard scores" (?)
Ratio	Determination of the equality of ratios	Similarity group $x' = cx$ $c > 0$	Geometric mean Harmonic mean Percent variation	Length, numerosity, density, work, time intervals, and so forth Temperature (Kelvin) Loudness (sones) Brightness (brils)

under the two conditions. Despite a change of illumination of perhaps several thousand-fold, the light parts of the picture look light and the dark parts dark. The perceived relation between light and shade within the picture remains highly stable, is subjectively constant. But just what is it that is subjectively constant, we may ask. There are at least two possibilities. One is that the subjective *difference* between the light and shade remains constant as we go from outdoors to indoors. The other is that the subjective *ratio* between the light and shade remains constant. If we could find out which of these relations holds, then we would know, for these conditions, the law that relates subjective brightness to the physical intensity of the stimulus.

Back in the 1850's two major figures in science, Fechner and Plateau, both considered the problem and reached quite opposite conclusions (a fact that suggests that you cannot settle the matter merely by looking at pictures!). Fechner argued that the subjective *difference* between light and shade remains constant, and that therefore the subjective brightness is a logarithmic function of stimulus intensity. That is the well-known Fechner's law. Plateau argued that the *ratio* remains constant, and that therefore the subjective brightness is a power function of stimulus intensity.

Formula-wise we may state these two laws as the relation between psychological value ψ and physical value ϕ in this way:

$$\text{Logarithmic law: } \psi = k_1 \log \phi$$

$$\text{Power law: } \psi = k_2 \phi^n$$

The exponent n is a constant whose value may vary with sense modality and with conditions of stimulation.

Of course, the champions of these laws cited other facts and evidence, and for a hundred years this issue has stood as a kind of antinomy in psychophysics. If you have heard only of Fechner in this connection, it is because it was he who defended his view more fiercely, who more tirelessly outargued his critics. Plateau's interest was only casual, and, as a matter of fact, he later changed his mind—and for a reason that was not really relevant (see *6*). So the field was left mainly to Fechner. But others revived the power law from time to time, and the contradiction persisted.

How can this conflict of opposing laws —the logarithmic and the power law— be resolved? By measurement, of course. All that is needed is a scale for the measurement of sensation. But that is easier said than done.

The Operational Principle

At this point, let me try to clarify a sticky issue. This question of sensation and its measurement has often gotten itself bogged down in metaphysical debate. Ever since Descartes set mind apart from matter, we have been trying in one way or another to put them back together again, for if we accept the dualistic view that mind is something apart, something inaccessible to science and measurement, the game is lost before the first move is made. To rescue science from this hopeless gambit, three modern developments have converged on a common solution. The three are behaviorism in psychology, operationism in physics, and logical positivism in philosophy (*11*). Despite certain differences in language and emphasis, all three of these movements have sought to clarify our scientific discourse by ridding its concepts of metaphysical overtones and untestable meanings. Under the operational view, length is what we measure with rods; time is what we measure with clocks. However well grounded in common sense may seem the notions of Absolute Space and Absolute Time, the physicist, as physicist, can *know* nothing about them—for he can *do* nothing about them.

Equally inaccessible are the nonoperational aspects of sensation. What we can get at in the study of living things are the responses of organisms, not some hyperphysical mental stuff, which, by definition, eludes objective test. Consequently, verifiable statements about sensation become statements about responses—about differential reactions of organisms. In psychology, perhaps even more than in physics, this operational stance is indispensable to scientific sense and meaning. In line with this necessity, let us agree that the term *sensation* denotes a construct that derives its meaning from the reactions, verbal or otherwise, made by an organism in response to stimuli. I know nothing about your sensations except what your behavior tells me. But what is equally true, we know nothing about the charge on the electron except for what its behavior discloses. We must be thoroughly operational in both instances.

Now, some will object that there is a difference here: that electrons do not study themselves, whereas men do. This is true enough. But if the science of man is to contain public, repeatable, verifiable generalizations, we must always in effect study the other fellow—we must pursue "the psychology of the other one." The psychologist as experimenter may look in upon himself if he cares to, and he may often thereby gain insight into fruitful hypotheses. But these hypotheses can lead to valid general laws only after they have been verified under experimental control on other people. If the experimenter serves as an observer in his own experiment, as I often do, he must proceed to treat his own responses as objective data, on a par with those of other observers. This manner of working, it seems to me, is the only sound, objective, operational approach. In what follows, therefore, I hope it will be taken for granted that I mean no more by sensation than what experiment tells us. Our goal is to make quantitative order of the reactions of sensory systems to the energetic configurations of the environment.

Conflicting Laws

Let us return now to our problem. Fechner, as I have said, won the first round, and for almost a century it looked as though the logarithmic law would prevail over the power law. Two rather convincing kinds of evidence seemed to favor it. First, there was the argument based on differential sensitivity, which we measure by noting how large an increment must be added to a stimulus in order for a person to detect the difference a certain percentage of the time. These just noticeable differences turn out to be roughly proportional to the magnitude of the original stimulus (Weber's law). There is a kind of relativity here. You can detect a candle added to a candle, but not a candle added to the light of the noonday sun. Fechner noted this principle and then proceeded to *postulate* that each just noticeable difference corresponds to a constant increment in sensation.

At this point we are reminded of what Bertrand Russell said in another connection about postulation: "The method of 'postulating' what we want has many advantages; they are the same as the advantages of theft over honest toil" (*12*).

Be that as it may, if we grant Fechner's postulate, and if Weber's law is true, it follows that sensation grows as the logarithm of the stimulus.

The other line of evidence is exemplified in the astronomer's scale of stellar magnitude, which appears to date from Hipparchus (about 150 B.C.). Before the days of photometry, men looked at the stars and judged their apparent brightness on a scale from 1 to 6, where 1 stands for the brightest stars and 6 for

the faintest. Successive numbers on the scale were assigned to successive equal-appearing intervals of stellar magnitude. Then an interesting thing happened. Men finally learned to measure the brightness of the stars by photometric methods, and, much to Fechner's delight, it turned out that the magnitudes assigned by the simple process of looking and judging were spaced by approximately equal steps on a logarithmic scale of photometric value. In keeping with this fact, the step on the modern scale of stellar magnitude has now been standardized at 4 decibels (0.4 log unit) (*13*). [Actually, the early astronomers' scales differed among themselves, and most of them were slightly, but systematically, different from the logarithmic scale (*14*).]

So here we have two classes of sensory measures lending some degree of credence to the logarithmic law: the results of measuring differential sensitivity and the results of *partitioning* a sensory continuum into equal-appearing intervals.

Then what about Plateau's view? Is there any experimental evidence that supports the power law? Actually, Plateau appears to have been the first experimenter to bring the partitioning method out of the heavens and into the laboratory; or, more precisely, into the studio, for he asked eight artists to paint a gray that would appear halfway between extreme black and white. The eight grays, independently produced, turned out to be "*presque identiques.*" Furthermore, the goodness of the partition into equal intervals—black to gray to white—appeared to remain stable under different degrees of illumination. Starting from this latter fact, Plateau conjectured his power law.

Unfortunately, for reasons we will consider shortly, the method of partitioning is not capable of verifying the power law. It was because Plateau did not know this fact that he later felt obliged to change his mind about the law. Actually, however, he never should have changed it, for he was right in his basic conjecture. The correct law is the power law.

Ratio Scale of Sensory Magnitude

In our struggle to discover the measures of things, we do not always hit upon the simplest and easiest procedure first off. Fechner's method of constructing a scale by the tedious process of measuring just noticeable differences and counting them off was involved and indirect—and even included one of Russell's larcenous

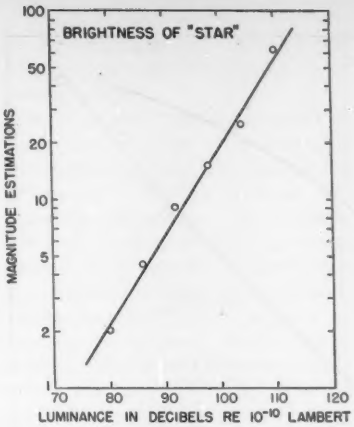

Fig. 1. Direct magnitude estimations of the apparent brightness of a small target subtending an angle of about 1.5 minutes of arc. The observer was first shown a luminance of 92 decibels and told to call it "10." Relative to this modulus he then estimated the other brightnesses, which were presented twice each in irregular order. Points are medians for 15 observers. The straight line in this log-log plot determines a power function with an exponent of 0.47.

postulates in the bargain. Plateau's method was more direct, certainly, but it aimed, at best, only at the construction of an interval scale—one on which the zero point would be arbitrary and on which ratios could have no meaning.

Clearly, if a ratio scale was to be achieved, judgments of subjective ratios would have to be made. In the early 1930's the first serious efforts to get people to respond to ratios of sensory magnitude finally got under way, and over the past few years a swelling tide of ratio scaling procedures has given this whole subject an exciting new look. It turns out that the ordinary thoughtful observer *can* make quantitative estimates of sensory events. He can adjust a light so that it appears half as bright as another, or a fifth as bright, or a tenth as bright. He can also set it to a given multiple of the apparent brightness of a standard light. Furthermore, given some standard brightness, to which is assigned an arbitrary value such as 10, the typical observer can assign numbers to other brightnesses proportional to their apparent level, as he sees them. These and several others are the procedures used.

On 17 different perceptual continua the application of these methods has resulted in power functions. To a fair approximation, estimated subjective magnitude is proportional to the stimulus magnitude raised to a power. The exponents, experimentally determined, have ranged from about 0.3 for loudness to 3.5 for the subjective intensity of electric shock applied to the fingers. The fundamental psychophysical law that emerges from these findings is simply this: equal stimulus ratios produce equal subjective ratios. That is all there is to it. The proportionality between stimulus ratios and subjective ratios is a pervasive first-order relation, observed in empirical studies on numerous perceptual continua. Second-order departures from this law are sure to exist (we already know about some of them), but the wide invariance of the first-order relation is a matter of prime importance.

I was particularly interested to see what form the ratio scale of subjective magnitude would take for small luminous targets resembling a star, for the astronomers' estimates of stellar magnitudes gave us the first psychological scale, though it was not a ratio scale. Fifteen subjects were asked to assign numbers proportional to the apparent brightness of a small spot of light resembling a star, whose intensity was varied over a range of 30 decibels (*15*). The median estimates gave a close approximation to a power function with an exponent of 0.47. Thus, the apparent subjective magnitude of the "star" grows approximately as the square root of the photometric level (see Fig. 1). (The exponent here is greater than that for larger luminous targets, where the exponent is close to one-third.)

Now the question arises, why did the early astronomers' scale approximate a logarithmic function, whereas direct estimations of apparent brightness give a power function? This stubborn question, which has long been a puzzle, actually turns out to have a very simple answer. It hinges on the fact that a person's sensitivity to differences (measured in subjective units) is not uniform over the scale—a fact related to Weber's law. A given difference that is large and obvious in the lower part of the range is much less impressive in the upper part of the scale. This asymmetry in the observer's sensitivity to differences produces a systematic bias whenever he tries to partition a continuum into equal-appearing intervals. On all continua of the class I have called "prothetic" (*6*), of which brightness is one, we observe that the scale constructed by partitioning into categories is a convex function of the ratio scale obtained by direct estimation—that is, the category scale plotted against the ratio scale gives a curve that is concave downward (see the upper curve in Fig. 2).

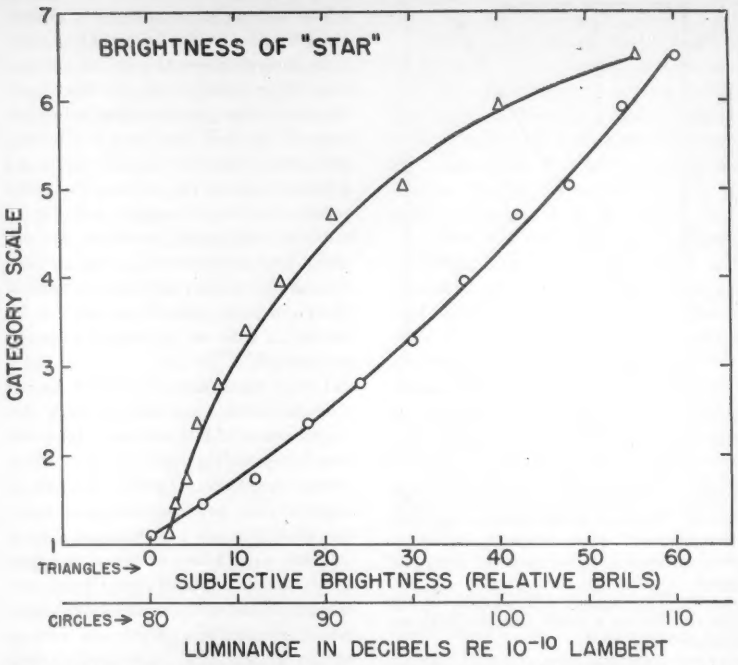

Fig. 2. Judgments of brightness on a category scale from 1 to 7. A luminance of 80 decibels was presented and called "1," and one of 110 decibels was presented and called "7." The observer then judged the various levels twice each in irregular order. Points are averages for 15 observers. The results are plotted against two different abscissa scales. The triangles are plotted against the magnitude scale obtained from the line in Fig. 1. The circles are plotted against the luminance scale in decibels. Note that the triangles determine a curve that is concave downward. The lower curve (circles) suggests that partitioning into a finite number of categories produces a function that is roughly logarithmic, but not precisely so.

The systematic bias that warps our judgments whenever we try to divide a segment of a prothetic continuum into equal-appearing intervals was presumably operating, of course, when the early astronomers arranged their scale of stellar magnitudes. The bias was apparently strong enough to make this scale approximate a logarithmic function of photometric intensity. But this roughly logarithmic outcome really helps Fechner's argument not at all, for when we look more carefully at the processes involved, we find that the form of the scale of stellar magnitudes is merely another example of the fact that man exhibits a built-in bias whenever he tries to partition a segment of a prothetic continuum. It is too bad that Plateau, when confronted with the results of another experiment on partitioning (conducted by Delboeuf), let himself be persuaded to renounce the power law.

Our confidence in the view that some kinds of partitioning are subject to bias gathers strength from the finding that not all partitioning is distorted in this manner. On another class of continua, called "metathetic," where sensitivity is not asymmetrical, the process of partitioning may produce an unbiased, linear scale (*15*). Pitch is an example of a metathetic continuum, whereas loudness is prothetic. With loudness, the physiological process underlying our discriminations seems to involve the *addition* of excitation to excitation. With pitch, the process is believed to be the *substitution* of excitation for excitation, a change in the locus of the excitation. It is indeed interesting that the difference between these two basic classes of physiological mechanisms reflects itself in the behavior of the psychological scales which we construct from the sensory responses involved.

The Ear as a Compressor

Since scales of measurement bear little fruit if they do not serve to predict or explain anything, it is fair to ask what other insights into natural phenomena may stem from this boom in sensory measurement. I do not pretend to know where it all will lead, but I would like to cite one final example of its bearing on an interesting question.

One of the amazing properties of a sensory system like hearing is the almost incredible dynamic range of its operation. Energy ranges of billions to one are taken easily in stride (*16*). In order to encompass such dynamic ranges, in order to detect sound vibrations whose amplitudes are less than the diameter of a hydrogen molecule and, at the same time, respond adequately to a thunderous roar, the sensory system must behave in some sense as a "compressor." The interesting question is, where does the compression take place—in the end organ or in the central nervous system?

First, it is to be noted that the degree of the compression we are concerned with is given by the exponent of the power function relating loudness to sound intensity (*16*). This exponent of about 0.3 tells us that in order to double the apparent loudness we must multiply the energy by a factor of about ten (or the sound pressure by the square root of ten). Contrast this relation with the growth of the subjective intensity of electric shock, which shoots up as the 3.5 power of the current applied to the fingers (*17*). Here, when we double the current, the typical observer judges the shock to be some nine or ten times as great as it was previously. There is no compression under this direct electrical stimulation. On the contrary, the system behaves as though it contained an "expander" of some sort. Through the direct measurement of sensory magnitudes, a striking difference is revealed between the behaviors of two sensory mechanisms.

Now the question is, what would happen if we were to stimulate the auditory nerve directly with an electric current? Some of us once explored this problem in a group of clinical patients whose middle ears had been opened, for one reason or another, so that an electrode could be placed inside the open cavity (*18*). Since other nerves, such as the facial and the vestibular, were readily stimulated under these circumstances, we had reason to believe that electrical stimulation also reached the auditory nerve, as indeed it must have done in those ears that heard only a noise whose character bore no systematic relation to the frequency of the stimulating current. A random, unpatterned excitation of the auditory nerve fibers would be expected to result from a current applied to the middle ear, and an unpatterned excitation of fibers

should lead to the perception of noise rather than tone.

The interesting thing, from our present point of view, was the rapid growth of the loudness of the noise as the current was increased. The patient was asked to compare the noise with a sound produced by an acoustic stimulus led to his normal, unoperated ear. He adjusted the loudness in his normal ear to match the loudness of the noise in the operated ear. This simple procedure disclosed a startling fact. The growth of loudness was many times steeper under electrical than under acoustical stimulation. The exponent of the power function under electrical stimulation was, in fact, of about the same order of magnitude as that observed when a 60-cycle current was applied to the fingers.

Many interesting questions are raised by these measurements, but one implication is clear. The "compression" observed in the normal response of the auditory system to a sound stimulus is apparently not an affair of the central nervous system, for if we bypass the ear and stimulate the auditory nerve directly, we detect no compression. Rather, there results an "expansion" in the subjective response. Apparently, therefore, it is to the end organ itself that we must look for the mechanism of compression that governs the slow growth of loudness with acoustic intensity.

So it appears that, with the aid of scales constructed for the measurement of sensation, we may have disclosed a fundamental difference between two transducer mechanisms. The transduction of sound energy into nervous energy is by way of an "operating characteristic" that somehow compresses the over-all sensory response. The transduction of electrical energy into nervous energy seems to follow quite a different rule. To be sure, this outcome is but a trifle in the vast and relentless contest to unwind the tangle of nature, but it testifies, in simple example, to the profit that may accrue from measuring the "unmeasurable" (*19*).

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News of Science

Science Education Legislation for 1958

Congressional hearings are now being held on proposed legislation for additional Federal support for education, especially science and language education, in the United States. There are two major bills. On 28 January, Senator H. Alexander Smith of New Jersey, for himself and 10 other senators, introduced a bill entitled the "Educational Development Act of 1958" (S.3163). This bill contains the recommendations that were presented in President Eisenhower's Education Message to Congress on 27 January. An identical bill (H.R.10278) was introduced in the House of Representatives by Carroll D. Kearns of Pennsylvania. On 30 January, Senator Lister Hill of Alabama, for himself and 26 other senators, introduced S.3187, a bill entitled "The National Defense Education Act of 1958." A companion bill (H.R.10381) was introduced in the House of Representatives on the same day by Carl Elliott of Alabama. Several other bills dealing with educational matters have been introduced, but this analysis will be confined to the two major bills. All of the Senate bills have been referred to the Committee on Labor and Public Welfare, and all of the House bills to the Committee on Education and Labor.

For purposes of identification in the following discussion the bill introduced by Senator Smith and Congressman Kearns will be referred to as the Administration bill; the one introduced by Senator Hill and Congressman Elliott, as the Hill-Elliott bill.

Purposes. Both are omnibus bills with broad objectives. The purposes are similar, but there are some interesting differences in wording.

The purposes of the Administration bill are "to encourage and assist in the expansion and improvement of educational programs to meet critical national needs through the early identification of student aptitudes, strengthening of counseling and guidance services in public high schools, provision of scholarships for able students needing assistance to continue their education beyond high school; strengthening of science and mathematics instruction in the public schools; expansion of graduate programs in colleges and universities, including fellowships; improvement and expansion of modern foreign language teaching; improving state educational records and statistics; and for other purposes."

The purposes of the Hill-Elliott bill are "to strengthen the national defense, advance the cause of peace, and assure

the intellectual preeminence of the United States, especially in science and technology, through programs designed to stimulate the development and to increase the number of students in science, engineering, mathematics, modern foreign languages, and other disciplines, and to provide additional facilities for the teaching thereof; to promote the development of technical skills essential to the national defense; to assist teachers to increase their knowledge and improve their effectiveness; to inform our scientists promptly and effectively of the results of research and study carried on in the United States and throughout the world; and for other purposes."

If the memory of some of the people on Capitol Hill is correct, the Hill-Elliott bill is the first in the history of the United States which specifically states the intention to ". . . assure the intellectual preeminence of the United States. . ."

In addition to the provisions described below, the Administration has recommended a very substantial increase in the budget of the National Science Foundation to enable the Foundation to increase its support for basic research, graduate fellowships in the sciences, and, in particular, improvement of teaching and education in the sciences. The proposed budget for science education is five times as large as the current appropriation. The Administration has adopted the position that programs that are confined to science and that involve direct negotiations with institutions of higher education are the responsibility of the National Science Foundation, while programs that include all fields of study, and those that are operated through state departments of education, are the responsibility of the U.S. Office of Education. With the exception of the science information service provisions of the Senate version of the Hill-Elliott bill, the bills discussed below concern programs that fall entirely within the responsibility of the Office of Education. Proposed expansions in the National Science Foundation programs will be discussed in a later issue of *Science*.

Student guidance. The authors of both bills recognize the importance of providing improved student counseling and guidance concerning immediate and future educational and vocational plans. To encourage the states to establish guidance programs or to expand existing ones, both bills offer matching funds, on a 50-50 basis, in support of state plans that meet the approval of the U.S. Commissioner of Education. The Administration bill offers up to $1.25 a year for each pupil in grades 9 through 12 (estimated total, $90 million in 4 years). The Hill-Elliott bill offers $15 million a year on a permanent basis, to be matched by the states in the third and succeeding years but not in the first two years.

Recognizing that there are not now enough well-trained counselors to provide the guidance service that is desired, both bills would authorize the Commissioner of Education to contract with colleges and universities to run special institutes for training counselors. In the Administration bill, the amount of money for this purpose is left to the discretion of Congress. In the Hill-Elliott bill the sum of $6 million a year is given and the stipend for persons attending summer institutes is set at $75 a week plus $15 a week for each dependent.

Scholarships. Both bills provide for a substantial undergraduate scholarship program. The Administration bill proposes an appropriation of $7.5 million the first year, with that much added each year until in the fourth and final year $30 million is appropriated. The Office of Education estimates that this money will provide about 10,000 new scholarships each year for four years. The Hill-Elliott bill calls for 40,000 scholarships a year for six years. In both cases, the scholarships are good for four years if the holder continues to do satisfactory work in college.

In both cases, money for the scholarships is to be allotted to state commissions in accordance with plans prepared by these commissions and approved by the U.S. Commissioner of Education.

Selection of scholarship winners is, in both bills, to be on the basis of ability. Scholarship holders may attend any accredited college or university that accepts them and may work in any field, but in both bills it is indicated that emphasis should be given to students who show particular interest and ability in science and mathematics. The Hill-Elliott bill gives equal emphasis to modern foreign languages.

There is an important difference in the nature and purpose of the scholarships proposed in the two bills. The Administration bill proposes to award a certificate to all winners and to allot an amount of money which is determined by the student's resources and needs. The purpose is to aid needy students to attend college, and scholarships are intended only for students who demonstrate need. The amount is not in any case to exceed $1000 a year and is expected to average about $750. In the Hill-Elliott bill, the scholarships are of $1000 a year and are independent of need. The scholarships are intended to recognize merit, and the authors hope that this program will stimulate intellectual interest and achievement widely throughout the high schools of the nation.

The Hill-Elliott bill includes several provisions which are not in the Administration bill. One is for an additional 20,000 scholarships for the first year (1958–59) for students who are already in college, or who have been in college, and who therefore are not eligible for the regular scholarships.

The Hill-Elliott bill also authorizes a loan fund of $40 million a year from which approved students could borrow up to $1000 a year. Repayment would not begin until one year after the date on which the borrower ceases to be a full-time student. Interest, at 2 percent, will not begin to accrue until the beginning of the time for repayment, nor will interest accrue while the student is in school, in the armed forces, or employed as a teacher at elementary, secondary, or collegiate level. The recipient of a loan who later becomes a teacher will have the loan canceled at the rate of 20 percent for each complete academic year of teaching.

An additional feature of student support, included in the Hill-Elliott but not in the Administration bill, is the proposal that there be appropriated $25 million a year, which will be made available to institutions of higher education that apply for grants. This money can be used to pay 50 percent of the cost of employing undergraduate students for work that is connected with the operation of the institution and, to the maximum extent possible, related to the field of study of the student. Again, special consideration is to be given to students of superior capacity and preparation in science, mathematics, engineering, and modern foreign languages.

Fellowships and graduate education. Both bills contain provisions for the support of graduate students, and in both the emphasis is on giving graduate training to students who are likely to become teachers in institutions of higher education. After that agreement, however, there is an important divergence in the two proposals. Under the Administration bill, grants would be made to individual universities. Each university would grant fellowships of such number and size as are recommended by the university and approved by the Commissioner of Education, and would be entitled to a grant of not more than $125,000 a year from which it could either (i) retain up to $500 a year for each student awarded a fellowship, or (ii) pay half of the additional salary and other costs chargeable to the establishment of a new graduate program or the expansion of an existing one. The amount for fellowships is not stated in the bill, but was given in the President's message as $2.8 million in the first year, rising to $12.6 million in the fourth year.

Under the Hill-Elliott bill, there would be awarded, on a national basis, 1000 fellowships the first year and 1500 addi-

tional ones in each of the next five years. Each would be tenable for up to three years. Fellows could attend any university that admitted them and would receive stipends of $2000 for the first postbaccalaureate year, $2200 for the second, and $2400 for the third. In each case, an additional allowance of $400 a year for each dependent would be authorized, as would an allowance of up to $1000 for payment to the university to help meet the costs of instruction.

Improvement of teaching. Both bills contain several provisions for the allocation of funds to state educational agencies or directly to educational institutions for the improvement of teaching. The Administration bill would authorize $15 million a year to state educational agencies, apportioned among the states in accordance with the number of school-age children, to pay one half the cost of approved programs for supervising instruction in science and mathematics; for improving science and mathematics curricula, instructional methods, and equipment; or for improving the undergraduate eduation in science and mathematics of students who expect to become teachers of those fields. To be eligible for grants, programs must either be new or be expansions of existing programs. They may be for elementary or secondary education.

The Hill-Elliott bill provides for allocation among the states of $10 million a year, on a matching basis, for paying or supplementing the salaries of science, mathematics, and modern foreign language consultants. In the Administration bill, the already mentioned provision for grants for supervision of the teaching of science and mathematics would allow the employment of consultants in these fields.

The AAAS can take a particular interest in these provisions, for both bills recognize the value of consultants similar to those sponsored by the AAAS in Nebraska, Oregon, Pennsylvania, and Texas for the past two years. These experienced and expert teachers have served as consultants in mathematics and science to high school teachers whom they have helped, on an individual basis, with their subject matter and teaching problems. This program has been enthusiastically endorsed by teachers and superintendents in the four areas in which the AAAS has (with funds provided by the Carnegie Corporation and with the cooperation of the state university and the state department of education) been able to establish these programs.

The Administration bill would also authorize $150 million a year to be allotted among the states, on a matching basis, to allow the employment of additional qualified science or mathematics teachers and to increase the compensation of science and mathematics teachers. This money might also be used for the provision of laboratory and other special teaching equipment. To be eligible for a grant, a plan would have to be approved by the state educational agency, and any teacher whose compensation is paid or increased under such a program would have to meet minimum qualifications set by the state.

Provisions under the Hill-Elliott bill are somewhat different. Forty million dollars a year would be made available for allotment to the states on the basis of a formula that takes into account both the size of the school-age population and the income per school-age child in the state. These funds would be available, on a matching basis, for approved projects to acquire facilities for the teaching of science and mathematics.

The Hill-Elliott bill would make an additional $40 million a year available for improving science and mathematics teaching facilities of institutions of higher education.

The Hill-Elliott bill also authorizes $75 million a year for payments to teachers who enroll for advanced study in summer sessions, and $25 million a year to teachers who enroll for advanced study in extension courses offered by institutions of higher education. Stipends for summer session work would be $75 a week plus $15 a week for each dependent. Stipends for extension study would amount to $7 for each day on which a course is attended plus tuition and university fees. Money for these purposes would be apportioned among the states, would be available for both elementary and secondary school teachers, and would not require matching by the states. Teachers in all fields of instruction would be eligible, but special consideration would be given to those who wanted to undertake advanced study in science, mathematics, and foreign languages and it would be required that the advanced study be in a subject matter field appropriate to the teacher's responsibilities.

Foreign language instruction. In the Hill-Elliott bill there is recognition of the special need to improve the teaching of modern foreign languages, and various provisions (scholarships, fellowships, teacher training, and so forth) apply to foreign languages as they do to science and mathematics.

The Administration bill devotes a special section to foreign languages and contains some provisions that are not found in the Hill-Elliott bill. Through grants or contracts with institutions of higher education, the Commissioner of Education is authorized to support short-term and regular session institutes for advanced training of teachers or prospective teachers of foreign languages, and to pay stipends to teachers attending these institutes. The institutes would be similar in character and purpose to those in the fields of science and mathematics that the National Science Foundation has supported for the past several years.

The Administration bill also authorizes the Commissioner of Education to make matching grants to enable institutions of higher education to establish and operate special centers for the teaching of those modern foreign languages for which the Commissioner determines that adequate instruction is not already available in the United States and for which the Federal Government, business, industry, or education needs teachers or translators.

To support the provisions described in the two preceding paragraphs, the Commissioner of Education is authorized to make studies of the need for training in foreign languages and to conduct research on methods of teaching and the development of specialized materials for language teaching.

Congressional citations. As a device for increasing student motivation, the Hill-Elliott bill authorizes the Commissioner of Education to award to the top 5 percent of high school graduates medals and scrolls bearing the inscription, "Congressional citation for outstanding scholastic achievement." No similar provision occurs in the Administration bill.

Vocational education. The Hill-Elliott bill provides $20 million a year, on a matching basis, for increased assistance to the states for training technicians in essential skills.

Science information service. The Senate version of the Hill-Elliott bill includes provisions for establishing a science information service within the National Science Foundation. The parallel bill in the House of Representatives does not contain these provisions, nor does the Administration bill. The reason for this one difference between the House and Senate bills is not disagreement over the desirability of a science information service but rather a difference in the operations of the House and Senate. The Senate bill has been referred to the Senate Committee on Labor and Public Welfare, which has cognizance over the National Science Foundation as well as educational activities. The companion bill in the House was referred to the Committee on Education and Labor, which has cognizance over educational matters but not over the activities of the National Science Foundation. Legislation in the House concerning a science information service can, therefore, more conveniently be embodied in separate legislation.

The Senate version of the Hill-Elliott bill authorizes the National Science Foundation to provide or arrange for the

provision of indexing, abstracting, translating, and other services leading to the more effective dissemination of scientific information, and also authorizes the Foundation to undertake programs to develop new or improved methods, including mechanized systems, for making scientific information available. No budget is included, but the bill authorizes the appropriation each year of such sums as may be necessary to carry out these provisions.

Research and information. The Administration bill authorizes the payment of up to $50,000 a year, on a matching basis, to assist any state to improve the adequacy and reliability of its educational statistics. This money is available only for new or expanded services.

The provisions of the Hill-Elliott bill are quite different: the Commissioner of Education is authorized to conduct, assist, and foster reseach on the development and use of television, radio, motion pictures, and related media of communication which may prove of value in education. In the next six years, $55 million would be provided for these purposes. Contracts may be written with educational or other institutions; motion pictures, film strips, recordings, and so on, may be purchased and adapted; and other materials may be obtained for these purposes.

Money and time. The Administration bill would, if enacted, last for four years. At the end of that time its authorization would expire, except for continuing to completion the scholarships and fellowships already granted. It is impossible to state precisely the cost, because dollar figures have not been established for all of the proposed programs. The cost would, however, increase slightly during the four years, because the total number of scholarship and fellowship stipends would increase. In round numbers, approximately $1 billion of Federal money would be called for over the four-year period.

The Hill-Elliott bill would extend for six years, but some of its provisions and authorizations would continue indefinitely. Partly because proposed expenditures in any one year are larger, and partly because the period of time covered is six rather than four years, the total amount of Federal money called for by the Hill-Elliott bill is approximately twice as great as the $1 billion of the Administration bill.

DAEL WOLFLE

AAAS

Control of Space Research

The Council of the Federation of American Scientists, an organization of some 2000 scientists and engineers, released a statement on 5 February that urges that "the most serious consideration be given by Congress and the Administration to placing further U.S. research and development in the field of outer space under civilian control," and that, further, "all outer space research by scientists of all nations be carried out under the aegis of a single international agency under the United Nations." The FAS statement also endorses legislation introduced in the Senate on 23 January by Senator Clinton P. Anderson (D., N.M.) "to achieve the development and control of outer space for peaceful purposes by the United States and all friendly nations working cooperatively. . . ."

Hearings on the proposal (S. 3117) opened on 6 February before the new Subcommittee on Outer Space Propulsion of the Joint Atomic Energy Committee. Anderson, who heads the subcommittee, would place United States space research under the Atomic Energy Commission, authorize a new national laboratory for space research, and urge establishment of an international space research laboratory [*Science* **126**, 331 (14 Feb. 1958)].

Other recent actions related to the administration of space research are as follows.

Senate space advisory group. On 6 February the Senate created a 13-member committee to explore the problems of outer space and recommend whether or not control of future programs should be under civilian or military auspices. A resolution authorizing the new committee was passed by a 78-to-1 vote just 24 hours after it was introduced by Senate Majority Leader Lyndon B. Johnson (D., Tex.). [Simultaneously, Representative Merwin Coad (D., Ia.) introduced a resolution in the House calling for a 31-member committee in that body to make a study of the problems of astronautics and space travel.] The new space group is made up of representatives of the following Senate committees: Appropriations, Foreign Relations, Armed Services, Interstate and Foreign Commerce, Government Operations, and the Joint Committee on Atomic Energy. All Senate bills dealing with astronautics and space exploration, now scattered among these committees, will go to the new committee.

Advanced Research Projects Agency. An Advanced Research Projects Agency to handle "the research and development phases of advanced science programs, including satellites and other outer space projects," was proposed by President Eisenhower in a request to Congress on 7 January for emergency funds to speed U.S. missile and defense programs. The House (15 January) approved a $549 million emergency defense bill, including authorization for establishment of ARPA. The Senate Armed Services Committee approved (28 January) the House-passed bill, but eliminated the provision for ARPA, indicating that it should be dealt with in separate legislation.

However, on 7 February Secretary of Defense Neil H. McElroy announced the establishment of ARPA and the appointment of Roy W. Johnson as its head. Johnson, a vice president of the General Electric Company of New York, will resign from General Electric on 1 April, but will spend two or three days a week on his new assignment prior to that date.

William M. Holaday, director of guided missiles in the Department of Defense, previously had been named to take charge of space planning. He and Johnson will decide between themselves when to transfer responsibilities. The Advance Research Projects Agency is the first federal agency created to devise rockets for outer space, antimissile missiles, satellites, and other vehicles for use in space.

NACA. The National Advisory Committee for Aeronautics proposed, in a resolution released 27 January, that it take over leadership of space research in cooperation with existing military and civilian scientific agencies. NACA director Hugh Dryden said the National Science Foundation and the National Academy of Sciences would plan scientific experiments: NACA would "conduct flights for scientific purposes within its capabilities or jointly" and expand its laboratories. NACA would work with ARPA, and eliminate the need for setting up a new agency or department. Said the *Washington Post* editorially (29 January):

"NACA's plan deserves sympathetic consideration. . . . A new civilian agency like the AEC would lack the advantage of established facilities, personnel, working relationships and experience. All-military control would be unwise . . . any hope of a joint Russian-American venture in space . . . would be seriously diminished by making the American role a military one."

Preparedness Committee proposals. In its Interim Report, released 23 January after extensive hearings, the Senate Preparedness Subcommitteee, which is headed by Senator Johnson, made 17 recommendations to improve the U.S. defense and missile organization. Included were the suggestions that (i) this country "provide for a freer exchange of scientific and technical information between the nations of the free world"; and (ii) "accelerate and expand research and development programs, provide funding on a long-term basis, and improve control and administration

within the Department of Defense or through the establishment of an independent agency."

Eisenhower on space control. On 12 January President Eisenhower wrote to Premier Bulganin: "I propose that we agree that outer space would be used only for peaceful purposes. We face a decisive moment in history in relation to this matter. Both the Soviet Union and the U.S. are now using outer space for the testing of missiles designed for military purposes. The time to stop is now. . . . If indeed it be the view of the Soviet Union that we should not go on producing ever newer types of weapons, can we not stop the production of such weapons which would use or, more accurately, misuse, outer space, now for the first time opening up as a field for man's exploration? Should not outer space be dedicated to the peaceful uses of mankind and denied to the purposes of war? That is my proposal. . . ."

National Federation of Abstracting Services

A National Federation of Science Abstracting and Indexing Services was formed last month at a 3-day meeting in Philadelphia (see editorial, "Strength through Union," in 14 February issue). The conference, which was organized by *Biological Abstracts* and supported by the National Science Foundation, was attended by 34 representatives of 14 United States abstracting and indexing services and 11 representatives of the following organizations: the AAAS, the NSF, American Geological Institute, the American Geophysical Union, UNESCO, and the U.S. Joint Publications Research Service.

The new federation will endeavor through cooperative measures, education and research to improve the abstracting, indexing and analysis of scientific information so that such information will be more readily available to all scientists and technologists in this country and throughout the English-speaking world.

The opening session of the conference was addressed by Detlev W. Bronk, president of the Rockefeller Institute and president of the National Academy of Sciences. He commented that the conference provided an example of American institutions working at their best, the participants having come together in an informal way to see how by cooperation they could improve their services and work together toward common goals. He deplored the growing tendency to believe that large and difficult tasks should be relegated to the Federal Government.

In the area of scientific information services, Bronk said that he does not think it necessary to create a large national scientific information center just because the Soviet Union has such a center.

The objective of the newly formed federation is to improve the documentation (abstracting, indexing, and analyzing) of the scientific and technological literature of the world in such a manner as to make it readily available to all scientists and technologists: (i) by encouraging the development of abstracting and indexing for those specialized subject fields not at present covered by such services, and the further development of existing services; (ii) by seeking greater uniformity in such matters as journal citations and abbreviations, and transliteration of foreign language titles; (iii) by cooperation, education, research, and the pursuit of mutually useful enterprises, to strive for the best possible research information services for science and technology in the United States and abroad.

Each of the abstracting and indexing services represented at the conference will name a representative to a temporary council to serve until the new federation is formally organized, at which time other eligible abstracting and indexing services will be invited to join. An interim executive committee of three will act for the temporary council in taking the necessary steps leading to the formal organization and incorporation of the federation. The members of the executive committee are G. Miles Conrad of Biological Abstracts, chairman; Dale B. Baker of Chemical Abstracts; and John C. Green of the Office of Technical Services, U.S. Department of Commerce. Funds for setting up a secretariat of the federation will be contributed on a voluntary basis by services represented at the conference as an expression of their interest in the development of the new organization. It is expected that grants and donations will help to maintain and to expand the activities of the federation.

Grants, Fellowships, and Awards

Cardiology. The American Heart Association has received a special grant from the National Heart Institute to permit a limited number of research scientists in the cardiovascular field to attend the third World Congress of Cardiology in Brussels, Belgium, 14–21 September. The funds will provide for round-trip air travel from New York to Brussels plus a per diem allotment during the Congress. Younger investigators who would otherwise be likely to experience difficulty in obtaining funds for this purpose will be given preference. Requests for application blanks should be sent *immediately* to the Assistant Medical Director for Research, American Heart Association, 44 23rd St., New York 10, N.Y.

Secondary School Teaching. The National Science Foundation has announced that it will accept proposals from universities and colleges interested in sponsoring in-service institutes for secondary school teachers of science and mathematics to be held during the academic year 1958–59. These especially designed in-service institutes will be held outside regularly scheduled school hours so that teachers may attend while still teaching full time in their schools. Foundation support to some 25 institutes will cover all tuition and fees, plus any other direct costs to the college or university directly attributable to the program. Though the foundation does not provide stipend support for participants in the in-service program, the NSF grants provide funds to underwrite travel expenses in connection with attendance at the institutes. Deadline for submission of completed proposals to the foundation is *15 March*. Directions for preparing proposals may be obtained from the Division of Scientific Personnel and Education, National Science Foundation, Washington 25, D.C.

Scientists in the News

NORMAN F. RAMSEY, professor of physics at Harvard University, has been appointed science adviser to Paul-Henri Spaak, Secretary General of the North Atlantic Treaty Organization. In the post, established by the NATO heads of government at their meeting in December, Ramsey will advise on all aspects of NATO activity in research, applied science, and the production of scientific manpower. He will act as chairman of the Science Advisory Committee, which is composed of scientific representatives from each of the NATO countries. This group was also established at the December meeting. At that time, the principal argument advanced in favor of closer scientific collaboration among the NATO powers was that the present compartmented national programs resulted in waste and duplication of effort. Ramsey will go to Paris in March to begin his new job.

The appointment of ADEN B. MEINEL as director of the new National Astronomical Observatory has been approved by the National Science Foundation. Meinel's appointment as first director of the observatory was recommended by the Association of Universities for Research in Astronomy, Inc., which is under contract to the National Science Foundation for the estab-

lishment and operation of a national astronomical observatory at a site to be selected in Arizona. Meinel has been associate director of the Yerkes and McDonald Observatories since 1953, but recently he has been on leave to work on the program for the new observatory.

Early in the spring of 1955 he began field work for the selection of possible sites for an astronomical observatory in the southwestern area. Assisted by H. A. Abt, Meinel made a comprehensive examination of the entire geographic region bounded by the Rio Grande on the east, the 36th parallel on the north, and the geographical limits of the United States on the south and west. All available rocket high-altitude photographs were carefully examined. The two scientists flew thousands of miles in a small plane and traveled great distances by car and jeep in the course of their examination of every possible site. Meinel will continue to direct work on the observatory from his present field office in Phoenix, Ariz., until such time as a site has definitely been selected.

CONRAD A. ELVEHJEM, biochemist and dean of the University of Wisconsin's Graduate School since 1946, has been elected 13th president of the university, effective 1 July. He succeeds EDWIN B. FRED, who will become president emeritus and emeritus professor of bacteriology. Elvehjem gained international prominence late in the 1930's when he isolated nicotinic acid, which led directly to the cure for human pellagra. He has been a leader in research in nutrition and vitamin B complex work.

PAUL M. FYE, associate technical director for research at the Naval Ordnance Laboratory, Silver Spring, Md., and special adviser for the Polaris Missile Program, has been named director of the Woods Hole Oceanographic Institution. He succeeds COLUMBUS O'S. ISELIN, who has been director of the institution since 1956, and who also served as director from 1940 to 1950. Iselin will continue to be associated with the institution and has been elected to be the first Henry Bryant Bigelow oceanographer, a chair founded recently by the board of trustees.

The National Academy of Sciences–National Research Council has announced that ERNEST H. VOLWILER is chairman-designate of its Division of Chemistry and Chemical Technology. Volwiler, president and general manager of Abbott Laboratories, will succeed FREDERICK D. ROSSINI on 1 July. Rossini, head of the department of chemistry at Carnegie Institute of Technology, has served as division chairman since 1 July 1955.

The first David Sarnoff Outstanding Achievement Awards in Science and Engineering are to be presented to ALBERT ROSE of the technical staff of RCA Laboratories, and DAVID K. BARTON of the engineering staff of RCA Defense Electronic Products. Rose is being cited "for basic contributions to the understanding and utilization of photoelectronic phenomena," and Barton for "important contributions to precise tracking radars."

The two awards, to be made annually to the outstanding scientist and the outstanding engineer of the Radio Corporation of America, were established in September 1956 to commemorate the 50th anniversary in radio of DAVID SARNOFF, chairman of the board of RCA. The medals will be presented to both men by Sarnoff early in March.

CHARLES H. TOWNES, professor of physics at Columbia University, has received the $2500 Research Corporation Award for his work in microwave spectroscopy. Townes' research has: (i) provided a new order of accuracy in the measurement of time—a ± 1-second deviation every 300 years; (ii) produced amplifiers some 100 times more sensitive than previously known types, thus expanding the range of radio astronomy; (iii) gained detailed information, previously unknown, on the structure of molecules by measuring the frequencies to which they respond.

NICOLAAS BLOEMBERGEN, Gordon MacKay professor of applied physics at Harvard University, was awarded the $1000 Oliver E. Buckley Solid State Physics Prize by the American Physical Society at its recent annual banquet. He was honored "for his studies of magnetic resonance both nuclear and electronic and of its uses in the investigation of solids, liquids and gases." The Buckley prize was endowed by Bell Telephone Laboratories in honor of the Laboratories' former president, who retired in 1952.

HERBERT FEIGL, director of the Minnesota Center for Philosophy of Science and professor of philosophy at the University of Minnesota, is serving as Carnegie visiting professor at the University of Hawaii in Honolulu from 4 February to 5 June. He is offering courses and seminars in the philosophy of science.

ALAN R. GRUBER has been appointed assistant chief engineer to head nuclear systems research in Astro, a division of the Marquardt Aircraft Company, Van Nuys, Calif. Gruber was formerly manager of the engineering department for the Nuclear Development Corporation of America, White Plains, N.Y.

LOUIS M. LAUSHEY, since 1954 professor of civil engineering and department head at Norwich University, Northfield, Vermont, will assume the corresponding post at the University of Cincinnati, effective 1 September.

RAYMOND J. EMRICH, professor of physics at Lehigh University, has been named head of the department of physics. He succeeds FRANK E. MYERS, who has been granted a 2-year leave of absence to accept appointment as associate director at Argonne National Laboratory, Lemont, Ill.

The Very Rev. MICHAEL P. WALSH has been appointed 22nd president of Boston College. He will succeed the Rev. JOSEPH R. N. MAXWELL, who has been president since 1951. Walsh has been chairman of the department of biology and director of premedical students at the college.

Recent Deaths

ALICE BRONFENBRENNER, Minneapolis, Minn.; 31; research investigator in the department of pediatrics, Variety Club Heart Hospital, University of Minnesota; 16 Jan.

ANDRE CROTTI, Columbus, Ohio; 84; physician and surgeon, world-famous for goiter surgery; at his retirement 3 years ago he had performed 16,000 thyroid operations; 31 Jan.

ERNST HEINKEL, Stuttgart, W. Germany; 70; aeronautical engineer and airplane manufacturer; jet aircraft pioneer; 30 Jan.

ALBERT E. HENNINGS, Vancouver, B.C., Canada; 78; professor emeritus of physics at the University of British Columbia; 13 Jan.

NEWMAN HOOPINGARNER, Halesite, N.Y.; 66; professor emeritus of business psychology at New York University's School of Commerce, Accounts and Finance; 27 Jan.

ALFRED E. HUDD, London, England; 75; inventor of a system of automatic train control; 3 Feb.

ERNEST H. KOCH, JR., Philadelphia, Pa.; 82; for 20 years before his retirement in 1942 he had been associated with the Brooklyn New York Technical High School as a teacher, vice principal, and dean; 28 Jan.

MAURICE STRAUSS, New Haven, Conn.; 65; clinical professor emeritus of dermatology of the Yale University School of Medicine; 3 Feb.

SAM F. TRELEASE, New York, N.Y.; 65; Torrey professor of botany at Columbia University; 1 Jan.

Paul E. Klopsteg, President-Elect

George R. Harrison

In its choice, each year, of an outstanding scientist to hold in succession its three top offices, the American Association for the Advancement of Science takes pains to have the various disciplines of science represented more or less evenly, in rotation, and also to keep some balance over the years among persons with experience in university, Government, and industrial scientific work.

In choosing Paul E. Klopsteg as its president-elect, the Association has been greatly aided in its problem of securing balanced representation by the fact that he has had long experience in all three types of service and has been an engineer as well as a scientist and an administrator. Dr. Klopsteg achieved distinction as president of the Central Scientific Company and as professor of applied science at Northwestern University and director of research at Northwestern Technological Institute and has served the Government in many capacities. Now, although ostensibly retired at the age of 68, he still serves actively as associate director for research of the National Science Foundation.

This wide range of experience has made Klopsteg's abilities invaluable to the armed services and to various other Government agencies throughout his career. It will enable him to bring to his presidency of the Association an unusually mature outlook and a firm understanding of current issues. Having already served two full four-year terms as a director of the Association, he knows its problems thoroughly. He has been on its Executive Committee since 1953 and has been a member of its Building Committee and its Investment and Finance Committee. He remains chairman of its Committee on Public Information in Science.

Not the least of the assets Klopsteg brings to his new office is a proven ability and willingness to participate actively in a seemingly endless series of committee meetings of the Washington type, some lasting for days on end. He does this amiably and with extreme conscientiousness, occasionally whiling away a particularly tedious stretch by solving a mathematical puzzle in surreptitious notes to a colleague, but forswearing, to a remarkable degree, the temptation to daydream about his happy home on Appletree Lane in Glenview, Illinois, where he might be carrying out his hobbies of archery, photography, shopwork, and gardening.

Klopsteg obtained valuable experience for his work as an officer of the Association through a series of important posts in other scientific societies. He was cofounder of the American Association of Physics Teachers in 1930 and served as president of that association in 1953. He was also, for 15 years, a member of the Governing Board of the American Institute of Physics and was chairman of its Board of Governors and its chief policy officer from 1938 to 1945.

Paul Ernest Klopsteg was born in Henderson, Minnesota, on 30 May 1889, son of the Reverend Julius Klopsteg and Magdalene Kuesthardt Klopsteg. His early days were spent in and near his birthplace, and he was graduated from the University of Minnesota in 1911, with a Bachelor's degree in electrical engineering. He showed an early interest in instrumentation and served as an assistant in the physics department of the University from 1911 to 1913, obtaining his Master's degree in that year, when he was given an instructorship. In 1916 he obtained his Ph.D. in physics and was soon made an assistant professor.

In 1917 Klopsteg left the University to become a development engineer with the Ordnance Department of the U.S. Army, serving at Aberdeen Proving Ground through 1918. After World War I he took a position as head of technical advertising at the Leeds & Northrup Company in Philadelphia. There he stayed until 1921, when he left to become director of research and manufacturing for the Central Scientific Company in Chicago. He was elected president of that company in 1930 and served in this capacity until 1944, when he became professor at Northwestern University, a position which he held until he reached the age of retirement in 1954.

In his capacities as director of research and president of the Central Scientific Company, Klopsteg made an immense contribution to American science by sponsoring and aiding in the development of a large number of new instruments and by improving many basic types of apparatus needed for teaching and for research. Of particular importance was his contribution to the development of the Cenco series of mechanical vacuum pumps, including the Hyvac and the Hypervac. I remember interrupting a transcontinental journey to call on him at his office in Chicago late one evening in the early 1930's, and finding the entire factory deserted except for President Klopsteg, who was busily making tests on a new pump model. He was greatly interested in providing new apparatus for the better teaching of physics and of science in general, and his vast knowledge of instrumentation lent much force and prestige to his direction of the company. In 1940 he received the Modern Pioneers award of the National Association of Manufacturers, and in 1942 he received an honorary Sc.D. degree from Northwestern University.

Klopsteg's unusual proficiency with instrumentation led to his being promptly selected, at the time the National Defense Research Committee was formed, in mid-1940, as vice chairman of its Instruments Section. This was a part of the division of N.D.R.C. of which Karl T. Compton was chairman, and the Instruments Section was assigned responsibility for all instruments and devices not in the purview of other branches of the committee. Among the weapons the scientists of this section came up with were the azon and razon dirigible bombs (which had to be rescued several times from pre-military oblivion). After Pearl Harbor the National Defense Research Committee was reorganized and combined with the Committee on Medical Research, the whole being set up as the Office of Scientific Research and Development. Klopsteg then became chief of the Physics Division, in charge of special devices—a post in which he served with great distinction from 1941 to 1945.

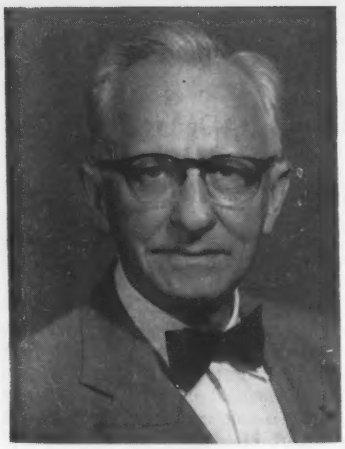
Early in 1944 he was appointed, in addition, assistant chief of the Office of Field Service, an Office of Scientific Research and Development organization under Karl Compton, which had the function of improving communication between the O.S.R.D. and the military commanders in the field, of expediting the provision of new scientific devices to the theatres of operation, and of determining the needs of the field commanders for scientific and medical help. Klopsteg was sent to the Hawaiian area, where he arranged for the setting up of a research section for General Richard-

Dr. Harrison is dean of the School of Science, Massachusetts Institute of Technology, Cambridge.

son. In the summer of 1944 he went out to General MacArthur's headquarters in Brisbane, Australia, where he took over the direction of a research section that had been set up by one of his colleagues a few months before. Soon after the Hollandia campaign he moved with MacArthur to the new general headquarters in New Guinea. For his very important war work, Klopsteg was awarded the Presidential Medal for Merit in 1948.

One of my most vivid wartime memories is of my peace-loving colleague Klopsteg shooting with a bow and viciously-tipped arrow at an old telephone directory in a San Francisco hotel room, while he and I were waiting to fly the Pacific to our respective assignments. Klopsteg has for many years been an enthusiastic toxophilite and had at that time already written numerous scientific papers on the theory and design of the bow. He had written a book entitled *Turkish Archery and the Composite Bow* and another called *Science Looks at Archery*. He had been chairman of the Board of Governors of the National Archery Association. As an ardent archer he had never shot an arrow in anger, or with any thought but of precision of aim. Now one of the needs of jungle fighting had been the development of a silent means of dispatching sentries at Japanese outposts, who at that time were eager to disembowel armed opponents or field-serving scientists with equal prejudice.

Klopsteg and I proceeded together to Hamilton Field, where, after several cancellations of flights of the Army's trans-Pacific planes, which were ferrying pilots across to New Guinea in great numbers, I saw Klopsteg off for Hawaii in a B-24 bomber. This was identified to us as being the plane that had carried Eleanor Roosevelt to the Antipodes a few months before. My own turn came a day later when I took off, also in a B-24 identified as "Eleanor Roosevelt's plane." This ferried me to Australia in some sixty hours, stopping once or twice a day at some available island for fuel and emergency repairs. Four months later, when Klopsteg came to Brisbane to relieve me, we saw on arrival at the airport for my departure a B-24 coming in from a trans-Pacific flight, which was soon identified to us as "Mrs. Roosevelt's plane." When I commented to Klopsteg that all B-24 bombers seemed to have been used by Mrs. Roosevelt, it developed that this particular plane (596) had flown him to Hawaii in one 14-hour flight, had returned immediately to the mainland, had then promptly ferried me to Australia during the following three days, and had, with three or four other planes, kept up this schedule almost continuously in the intervening four months.



Paul E. Klopsteg

During Klopsteg's years as president of the Central Scientific Company he had made wide contact with the American scientific community. The mass of material waiting to be published in physics archives journals each year was, in 1930, growing at so alarming a rate that it became important to work out new publication procedures. Also, the various physics societies were showing signs of going off in divergent directions. The industrial and the university physicist were beginning to forget that they had much in common. In 1931, Karl T. Compton of Massachusetts Institute of Technology, George B. Pegram of Columbia, Paul D. Foote of the Gulf Oil Co. Research Laboratories, and others joined in founding the American Institute of Physics, an association dedicated to the unification of American physics and the effective publication of physics journals, which grouped together the American Physical Society, the Optical Society of America, the American Acoustical Society, the American Association of Physics Teachers, and a number of other societies of physicists.

The American Institute of Physics now serves as the publisher of nine physics journals and is an active clearinghouse for American physics. Its membership of about 20,000 includes most American physicists. Klopsteg, soon after its founding, became a member of its Board of Governors and eventually served as its third chairman, following Karl T. Compton and John T. Tate.

At the conclusion of World War II, Klopsteg left his part-time position as chief of the Special Devices Division of the Office of Scientific Research and Development to become chairman of the Prosthetics Committee of the National Research Council, where he contributed greatly to its valuable work on the development of improved artificial limbs. He remained in this post until 1956 and continues as a member of its successor committee, the Prosthetics Research Board.

During the latter part of the war Klopsteg had decided to give up his connection with the manufacture of scientific instruments and had accepted a position of great responsibility with Northwestern University, which, at the time, was establishing its Technological Institute. As adviser to the dean of the institute, he was put in charge of research activities and remained in a professorial capacity until his so-called retirement. During this entire period Klopsteg kept up his service with the Government. He was appointed a member of the Board of Governors of the Argonne National Laboratory in 1949 and, later, became its chairman. He has also served as a member of the Personnel Security Review Board of the Atomic Energy Commission, since 1953, and on numerous other committees.

On the founding of the National Science Foundation, Klopsteg became its assistant director for physical sciences. Since 1952 he has been an associate director, becoming associate director for research in 1957. In one capacity or another he has served as a close advisor to Dr. Alan Waterman during the entire period since the founding of the National Science Foundation. These and his other governmental duties have required almost continuous commuting between Chicago and Washington for the past 17 years. But Klopsteg is a seasoned traveller, for, in addition to his several trans-Pacific flights, he and Mrs. Klopsteg encircled the globe in 1951, going to Pakistan, where he was an invited adviser to a commission appointed by the Punjab Government to study its university system and science education at the lower levels.

In 1914 Klopsteg married Miss Amanda Toedt of Laurel, Iowa, and was long a happy paterfamilias with their three daughters, Marie, Irma Louise (who died in adolescence), and Ruth.

Dr. Klopsteg brings to his new office the vigor and energy that have characterized his activities for many years. The Association can expect him to be a dedicated and able president-elect and president. We are all fortunate that he has responded to the call to cap long service on the Board of Directors with an additional period as one of the triumvirate of leaders that directs the fortunes of the Association.

AAAS Council Meeting, 1957

Dael Wolfle

The Association's Council, consisting of officers and the designated representatives of affiliated organizations, met in two sessions at the Hotel Claypool in Indianapolis. The first session convened at 4 P.M. on 27 December; the second at 9 A.M. on 30 December. President Laurence H. Snyder presided. Attendance at the first session was 145, and at the second, 101.

Elections and Officers

By mail ballot, prior to the meeting, the Council had elected Paul E. Klopsteg as president-elect and had reëlected Thomas Park and William W. Rubey as members of the Board of Directors. The President announced that the Board had elected Mina S. Rees to fill out the unexpired portion, three years, of the term on the Board left vacant by the election of Dr. Klopsteg as president-elect.

A list of the committeemen-at-large elected by the sections was read. The Board approved the nominations from the sections, and the Council elected the vice presidents and chairmen of sections for 1958 whose names and sections are listed on pages 401–402. The President announced the election by the Board of the following persons to serve four-year terms as section secretaries: Frank B. Wood, University of Pennsylvania, Section D–Astronomy, and Howard B. Sprague, Pennsylvania State University, Section O–Agriculture. (Subsequent to adjournment of the Council meeting, the Board elected the following section secretaries: Karl M. Wilbur, Duke University, Section F–Zoological Sciences; James L. Giddings, Brown University, Section H–Anthropology; and John W. Streeter, Fels Planetarium, Franklin Institute, Section L–History and Philosophy of Science.)

To serve for two-year terms on the Nominating Committee, the Council elected Clinton L. Baker, Edward F. Degering, and Robert Bruce Lindsay.

The Committee on Nominations proposed that in the future only one name appear on the ballot for election of the Association's president-elect. (Two or more names would continue to be proposed for each vacancy on the Board of Directors; suggestions would continue to be solicited from the Council; and Council, by petition signed by 30 or more members, would retain the right to add names to the ballot for president-elect.) After discussion of the relative merits of different arrangements, Council voted to retain the present system, under which the Committee on Nominations submits two or more names as candidates for president-elect.

Changes in Constitution and Bylaws

At the 1956 meeting, Council requested the Board to consider ways in which the Association could continue to make use of the experience and interest of the Association's past presidents. In response to this request, the Board recommended that the constitution be amended to include past presidents as members of the Council. Council approved this recommendation in voting to amend Article IV, Section 2, by adding the italicized words in the passage: "The Council shall consist of (a) the president-elect, the president, the retiring president, *all past presidents,* the vice presidents, the secretaries of the sections. . . ."

The President announced that the Board of Directors had adopted two amendments to the bylaws. One consisted of *deleting* the italicized words in Article X, Section 1: "The publications of the Association shall be (*a*) Science, (*b*) *The Scientific Monthly,* (*c*) *Proceedings,* and (*d*) such other *special* publications as the Board of Directors may direct." The other consisted of *adding* the italicized words to Article VII, Section 3: "The Southwestern and Rocky Mountain Division (organized in 1920) includes members of the Association resident in Arizona, New Mexico, Colorado, Wyoming, Montana east of the Continental Divide, Sonora, Chihuahua, and *those portions of* Texas *and Oklahoma* west of the 100th meridian."

Resolutions

Upon recommendation of the Committee on Resolutions, consisting of C. C. MacDuffee, chairman, J. Howard McMillen, and Stuart A. Rice, Council voted to adopt the following resolutions:

"RESOLVED, that the following cablegram be sent in the name of the American Association for the Advancement of Science to A. Nesmejanow, President of the Academy of Sciences of the Union of Socialist Soviet Republics: 'The American Association for the Advancement of Science, convened in Indianapolis, Indiana, in its annual meeting, sends greetings to its fellow scientists in the Soviet Union and congratulates them upon their scientific and technological achievements, including those manifested in the launching of earth satellites.'"

"RESOLVED, that the Council of the AAAS approves in principle the general adoption of the metric system of weights and measures. It tenders its cooperation to the British Association in any practicable efforts to further this objective."

Upon motion made from the floor, the above resolution was amended by the addition of:

"RESOLVED FURTHER, that a committee be appointed by the American Association for the Advancement of Science to make a study of the most economic and feasible methods of changing over to metric usage in their own and allied fields, to be reported upon at the next meeting of the AAAS in Washington."

"WHEREAS, it is desirable that financial contributions by the American people to the support of science and education be increased, and WHEREAS, the tax incentives to make such contributions are relatively great for taxpayers in upper income brackets but decrease, relatively, as income tax liability decreases; therefore RESOLVED, that the Council of the AAAS favors such revisions of Federal and State income tax laws as will provide greater incentives to contribute to education and science."

"WHEREAS, there is a serious shortage of well-qualified secondary school teachers of mathematics and science, and WHEREAS, the subject matter training of such secondary school teachers requires a program substantially different from the regular courses in either subject matter or educational methods; therefore RESOLVED, that the AAAS advocate that institutions of higher education establish programs of study in mathematics and science especially designed with emphasis on subject matter to meet the needs of secondary school teachers. Depending upon the educational policy of the institution and the requirements of a particular state, the program of study may be designed to lead to a master's degree

or to some alternative arrangement of courses and credits necessary to accomplish the purpose of the program."

"RESOLVED, that the American Association for the Advancement of Science express to the State of Indiana and to the City of Indianapolis its sincere appreciation of the efforts of its citizens in making the annual 1957 meeting so successful and enjoyable; and RESOLVED FURTHER, that the AAAS extend its appreciation in particular to A. H. Fiske, General Chairman, Newton Sprague, and all other committee chairmen; to Joseph J. Cripe of the Indianapolis Convention Bureau and his assistants; to William H. Book of the Indianapolis Chamber of Commerce and his assistants; to Indiana University Medical Center; to Butler University; to the World War Memorial; to the Murat Temple; and to the management of the many hotels and other organizations whose courtesies have contributed so much to the success of these meetings."

The following additional resolution, presented by H. H. Plough, was adopted by Council vote:

"WHEREAS, in the present period of concern over technological development in the United States, the public may misunderstand the basic needs of science, and WHEREAS, in attempting to emphasize technology there is a danger that support of research in basic sciences may be diverted and that scientific development in certain areas, which will be greatly needed in the future, may even be reduced; therefore RESOLVED, that the American Association for the Advancement of Science urges recognition that science is a major element in the peacetime strength of our country, that stimulation of activity in technology alone is not enough to increase or even to maintain this strength, and that scientific development in all areas needs continued and increased support; and RESOLVED FURTHER, that any effort to stimulate science in our country must take into account the unity of nature and must recognize the need for research in all classes of natural phenomena, whether physical or biological. It is urged, therefore, that in addition to development of technology, increased recognition and adequate continuing financial support shall be given to basic physical, medical, biological, and social sciences, and to scientists in these fields."

Affiliates

Upon recommendation of the Committee on Affiliation and with the endorsement of the Board of Directors, Council voted to elect the following eight organizations as affiliates: Chicago Academy of Sciences, Rochester Academy of Science, Montana Academy of Sciences, American Association of Bioanalysts, American Astronautical Society, Geochemical Society, Institute of Management Sciences, and Paleontological Research Institution. With these elections, the number of affiliated organizations is now 279.

AAAS Operating Fund Budget, 1958: Receipts

Item		Estimated receipts
Dues of annual members		$450,000
Journal subscriptions for emeritus members		5,300
Nonmember subscriptions		65,000
Miscellaneous Sales		
Science	$ 3,500	
The Scientific Monthly	300	
Advance galleys	450	
		4,250
Advertising		300,000
Sale of:		
Microcards	600	
Binders	1,000	
Symposium volumes	35,000	
Emblems	2,000	
		38,600
Meeting and exposition		30,000
Rental receipts		22,000
Income from investments		10,000
Cash discounts		300
Overhead		20,000
Other receipts		1,000
Total receipts		$946,450

Legislation Affecting Science and Education

Council discussed at some length the question of how the Association could contribute most constructively to the consideration of the various proposals that are being made, for Federal legislative action and for action through other means, to increase the support of scientific research and to improve education, particularly in science and mathematics. As a conclusion to the discussion, Council voted to request the Board of Directors to arrange for the holding, as soon as practicable, of a widely representative meeting of scientists to discuss and formulate recommendations concerning the current issues affecting science and education. Subsequently, the Board appointed Warren Weaver as chairman of a committee to plan the meeting. Other members of the committee are Wallace R. Brode and Dael Wolfle (ex officio), Barry Commoner, T. Keith Glennan, Paul M. Gross, Mark H. Ingraham, and Donald Marquis, with Detlev W. Bronk and Alan T. Waterman as consultants.

Social Aspects of Sience

Chauncey D. Leake, chairman of the Committee on the Social Aspects of Science, submitted the following committee report:

"At the 1955 Atlanta meeting of the AAAS, Dr. Ward Pigman proposed a program for dealing with social aspects of science. An Interim Committee was appointed to survey the matter. With Dr. Pigman as chairman, this committee reported at the New York 1956 meeting, with the results of the survey published in *Science* on January 25, 1957. At the New York meeting of AAAS, the Council adopted the following resolution:

" 'WHEREAS, one of the purposes of the AAAS is "to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress," and WHEREAS, the present rapid advance of science is accompanied by social problems of unprecedented magnitude that affect human welfare; therefore RESOLVED, that in recognition of the responsibility of scientists to participate in deliberations regarding the use made

of new scientific knowledge, the Council of the AAAS authorizes the President to continue the work of this committee by appointing an enlarged group for the purpose of defining the problems, assembling the relevant facts, and suggesting a practical program, to be submitted to the AAAS Board of Directors, to implement the objectives of the AAAS in this regard.'

"On appointment from President Laurence H. Snyder, this committee was organized in the spring of 1957, and has held four meetings, with Chauncey D. Leake as chairman.

"Six subcommittees have been appointed: (1) on AAAS planning with relation to social aspects of science, Ward Pigman, chairman; (2) on authoritarianism in relation to science, Lawrence Kubie and T. C. Byerly, cochairmen; (3) on support and organization of scientific research and education; (4) on man-made problems of the physical environment, Barry Commoner, chairman; (5) on the social effects of scientific activities, Margaret Mead, chairman; (6) on the role of science in general education and culture; and (7) on communication with the public on scientific matters, Jack Geiger, chairman. In addition to these chairmen of subcommittees, the general committee includes Stuart A. Rice, Robert K. Merton, and David D. Rutstein. The subcommittees have made preliminary surveys of the matters with which they are concerned.

"As reported in the *New York Times* of November 16, the committee considered issuing statements to the public on current social issues relating to science. After failing to agree on a satisfactory statement on radiation hazards, it was decided that such a statement might be unwise, since it might suggest an authoritarianism which is repugnant to the ideals of scientific effort. The committee holds that scientists are within their competence in furnishing scientific data on social problems and in suggesting the consequences of the facts as far as they are verifiable. However, scientists are probably no wiser than other intelligent citizens in reaching policy decisions on major social issues.

"The committee, therefore, at the suggestion of Paul E. Klopsteg, President-Elect, hopes to persuade private scientific groups, including the AAAS, to organize conferences on social aspects of science, the discussions of which could be reported to and reviewed for the public. One such conference, with representative speakers from competent sources, discussed radiation hazards at the Indianapolis meeting, on December 29, 1957, with wide press coverage, and with reports to be published in fuller detail. As appropriate subjects for other such conferences, the committee suggests such social problems involving science as it has already considered: (1) the role of science in government; (2) attitudes of authoritarianism in relation to science; (3) population and nutrition problems; (4) pollution of airs and waters; (5) support of fundamental scientific research directed to the acquisition of new knowledge about ourselves and our environment; (6) science and ethics; and (7) the role of science in culture and education. Some of these subjects have already been included in symposia arranged for general meetings of the AAAS. The committee also suggests the promotion of local neighborhood discussion groups on social aspects of science, led by local scientists, where interested citizens might learn what science is about, and why it is important that our children get early and much science training in our schools, without sacrificing humanistic studies.

"These matters have been carefully considered by your committee and also by the AAAS Board of Directors. The Board has indicated its interest in and support of the work of your committee. The Board is aware of the growing responsibilities of scientists in regard to

AAAS Operating Fund Budget, 1958: Expenses

Item	Estimated expenses per item	Estimated expenses (totals)	Limits on individual items
General administrative expenses			
Salaries	$200,000		$220,000
Insurance, retirement, and social security	17,000		18,000
Building maintenance	40,780		44,000
Interest on mortgage	6,550		6,600
Office supplies	18,000		20,000
Telephone and telegraph	2,500		3,000
Postage and freight	12,500		13,500
Travel	3,500		4,000
Outside services (mailing, secretarial)	6,500		8,000
Equipment news	1,000		1,200
Audit, personal property tax, insurance, etc.	3,500		5,000
		$311,830	
Printing and manufacturing			
Science	450,000		475,000
Symposium volumes	27,000		30,000
Binders	800		1,000
Microcards	450		600
Emblems	700		1,000
		478,950	
Annual meeting			
Meeting and exposition	19,000		21,000
Press service	5,000		5,500
		24,000	
Sections, divisions, boards, and committees			
Section expense	5,000		5,800
Division allowance	8,600		9,000
Board of Directors	6,000		6,500
Editorial Board	7,000		7,500
Other committees	3,000		3,500
		29,600	
Other expenditures			
Advertising	75,000		85,000
Executive Officer's discretionary fund	5,000		
Contingencies and new activities	10,000		
		90,000	
Depreciation			
Building	23,200		
Furniture and equipment	5,400		
		28,600	
Total operating expenses		$962,980	

the social consequences of scientific progress, and is seeking appropriate ways to aid scientists in analyzing and meeting these responsibilities. The Board offers to try to find funds to help hold symposia or conferences for the purpose of exploring various features of the social impact of science, as suggested by the committee, and in making available to the public the reports and discussions of such sessions."

Future Council Meetings

In order to give members of the Council greater responsibility for the planning of Council meetings, Council voted to extend the functions of that committee; to ask the President to name the committee members, well in advance of the annual meeting; to rename the committee as the Council Agenda and Resolutions Committee; to instruct the committee to solicit, coordinate, and circulate suggestions of Council members relating to the proper and desirable activities of the Council, the Board, or the Association; and to arrange for the circulation of summaries of background facts and opinions on these proposals to the Council in advance of the annual meeting.

The President asked Council for advice about the scheduling of Council meetings, pointing out that since the election of the president-elect and members of the Board is now handled by mail ballot, it is no longer necessary to devote a substantial portion of the first Council session to balloting for these offices. After discussion of the possibility of holding only one Council session and after defeat of a motion that Council hold two sessions on the same or succeeding days, it was agreed to continue the present system of holding two sessions, with one relatively early and the other toward the end of the period covered by the annual meeting.

Finances

The Executive Officer described briefly the budget that had been approved by the Board of Directors for 1958. It is presented in the accompanying tables. He also announced that preliminary estimates of 1957 income and expense indicated that the two would be approximately in balance instead of showing the deficit that was expected when the budget was approved, a year earlier.

During 1957 the Association received the following gifts and grants: $113,960 from the National Science Foundation for the expenses of distributing traveling libraries of science books to 216 high schools throughout the United States; $10,000 from the National Science Foundation for the Gordon Research Conferences; $5100 from the National Science Foundation to pay expenses of a conference of representatives of academies of science to consider problems of fostering the work of junior academies of science; $4000 from the National Science Foundation for the costs of holding a series of colloquia for scientists in the Washington, D.C., community; $100,000 from the Carnegie Corporation as the third and final portion of the grant to support the Science Teaching Improvement Program; $20,000 from the Ford Foundation toward the expenses of a study of the effect on tax revenue and contributions of changes in income tax provisions designed to increase voluntary contributions; $5000 from the Ford Foundation for the cost of a series of small conferences and discussions of actions that should be taken to stimulate research in the behavioral sciences; and approximately $9000 from various sources as contributions to the expenses of the New York and Indianapolis meetings, for the Association's building fund, and for other purposes.

Membership figures indicate that the total membership increased by 3000 during the year. In reporting membership figures, special attention was given to an effort to determine the effects that might be attributable to the increase in dues and to the merger of *Science* and *The Scientific Monthly*, both of which became effective on the first of January 1958. Active resignations as of 19 December 1957 totaled 640 in comparison with 537 as of 31 December 1956. The increase in resignations was approximately equal as between members who subscribed to *Science* and those who subscribed to *The Scientific Monthly*. Much more than offsetting the increase in resignations was the fact that the number of members who, as of mid-December, had not yet paid dues for the following calendar year was 1500 smaller at the end of 1957 that it had been at the end of 1956. These figures indicate that the Association suffered no material loss from the dues and publication changes.

AAAS Officers, Committees, and Representatives for 1958

The following persons are serving as officers, as members of the indicated committees, and as representatives to other organizations for the year 1958. The dates in parentheses indicate the year of expiration of terms of election or appointment.

General Officers

President: Wallace R. Brode (1959), Department of State

President-Elect: Paul E. Klopsteg (1960), National Science Foundation

Retiring President and Chairman of the Board of Directors: Laurence H. Snyder (1958), University of Oklahoma

Other Members of the Board of Directors

Chauncey D. Leake (1958), Ohio State University

Margaret Mead (1958), American Museum of Natural History

Paul M. Gross (1959), Duke University

George R. Harrison (1959), Massachusetts Institute of Technology

Mina S. Rees (1960), Hunter College

Alan T. Waterman (1960), National Science Foundation

Thomas Park (1961), University of Chicago

William W. Rubey (1961), U.S. Geological Survey, Washington, D.C.

Paul A. Scherer (ex officio), Carnegie Institution of Washington

Dael Wolfle (ex officio), AAAS

Vice Presidents and Chairmen of the Sections

A Mathematics: G. A. Hedlund, Yale University

B Physics: Robert Bruce Lindsay, Brown University

C Chemistry: F. O. Rice, Catholic University

D Astronomy: Dirk Brouwer, Yale University

E Geology and Geography: Byron N. Cooper, Virginia Polytechnic Institute

F Zoological Sciences: Harold H. Plough, Amherst College

G Botanical Sciences: Oswald Tippo, Yale University

H Anthropology: A. Irving Hallowell, University of Pennsylvania

I Psychology: B. F. Skinner, Harvard University

K Social and Economic Sciences: Joseph J. Spengler, Duke University

L History and Philosophy of Science: Carl B. Boyer, Brooklyn College

M Engineering: Clarence E. Davies, 32 West 40th Street, New York

N Medical Sciences: Gordon K. Moe, New York State College of Medicine, Syracuse

Nd Dentistry: George C. Paffenbarger, National Bureau of Standards

Np Pharmacy: George F. Archambault, U.S. Public Health Service, Washington, D.C.

O Agriculture: Roy D. Hockensmith, U.S. Department of Agriculture, Washington, D.C.

Q Education: Harry A. Cunningham, Kent State University

Administrative Officers

Appointed by the Board of Directors

Executive Officer: Dael Wolfle

Treasurer: Paul A. Scherer

Associate Administrative Secretary: Raymond L. Taylor

Editor: Graham DuShane

Educational Director: John R. Mayor

Secretaries of the Sections

A Mathematics: C. C. MacDuffee (1960), University of Wisconsin

B Physics: J. Howard McMillen (1959), National Science Foundation

C Chemistry: Edward F. Degering (1960), 26 Robinhood Road, Natick, Mass.

D Astronomy: Frank B. Wood (1961), University of Pennsylvania

E Geology and Geography: Frank C. Whitmore, Jr. (1960), U.S. Geological Survey, Washington, D.C.

F Zoological Sciences: Karl M. Wilbur (1961), Duke University

G Botanical Sciences: Barry Commoner (1959), Washington University, St. Louis

H Anthropology: James L. Giddings (1961), Brown University

I Psychology: Clifford T. Morgan (1960), Town Point, Cambridge, Md.

K Social and Economic Sciences: Donald P. Ray (1958), George Washington University

L History and Philosophy of Science: John W. Streeter (1961), Fels Planetarium, Franklin Institute

M Engineering: E. Paul Lange (1960), Engineers Joint Council, New York, N.Y.

N Medical Sciences: Allan D. Bass (1960), Vanderbilt University School of Medicine

Nd Dentistry: Russell W. Bunting (1958), University of Michigan School of Dentistry

Np Pharmacy: John E. Christian (1958), Purdue University School of Pharmacy

O Agriculture: Howard B. Sprague (1961), Pennsylvania State University

P Industrial Science: Allen T. Bonnell (1960), Drexel Institute of Technology

Q Education: Herbert A. Smith (1959), University of Kansas

Officers of the Alaska Division

President: Robert Rausch, Box 960, Anchorage

Vice President: Edward L. Keithahn, Box 97, Juneau

Secretary: Mrs. Willetta B. Matsen, Box 960, Anchorage

Treasurer: Clyde J. Beers, U.S. Coast and Geodetic Survey, College

Council Representative: Victor P. Hessler, Box 497, College

Officers of the Pacific Division

President: Ian Campbell, California Institute of Technology

President-Elect: Henry Eyring, University of Utah

Retiring President: J. Murray Luck, Stanford University

Secretary: Robert C. Miller, California Academy of Sciences

Council Representative: Robert C. Miller

Officers of the Southwestern and Rocky Mountain Division

President: M. F. Stubbs, New Mexico Institute of Mining and Technology

Vice President: Albert R. Mead, University of Arizona

Executive Secretary-Treasurer: Marlowe G. Anderson, New Mexico College of Agriculture and Mechanic Arts

Council Representative: Marlowe G. Anderson

Editorial Board

Graham DuShane, AAAS, chairman

Bentley Glass (1958), Johns Hopkins University

Karl Lark-Horovitz (1959), Purdue University

Edwin M. Lerner (1964), National Institutes of Health

William L. Straus, Jr. (1963), Johns Hopkins University

Edward L. Tatum (1962), Rockefeller Institute for Medical Research

Standing Committees

AAAS Meetings

Arthur W. Galston (1959), Yale University, chairman

Ronald Bamford (1958), University of Maryland

Ellis A. Johnson (1960), Operations Research Office, Johns Hopkins University

Howard M. Phillips (1958), Alabama College

Robert C. Stephenson (1958), American Geological Institute, Washington, D.C.

Dael Wolfle, AAAS, ex officio

Raymond L. Taylor, AAAS, staff representative

Affiliation

I. Melville Stein (1962), Leeds & Northrup Company, Philadelphia, Pa., chairman

John B. Buck (1958), National Institutes of Health

Herbert Carter (1959), University of Illinois

Earl L. Green (1961), Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me.

Luna B. Leopold (1960), U.S. Geological Survey, Washington, D.C.

Dael Wolfle, AAAS, ex officio

Raymond L. Taylor, AAAS, staff representative

Executive Committee of the Board of Directors

Laurence H. Snyder, chairman

Wallace R. Brode

Paul E. Klopsteg

William W. Rubey

Paul A. Scherer

Dael Wolfle

Investment and Finance

F. P. H. Siddons (1962), American Security & Trust Company, Washington, D.C., chairman

Malvern F. Morse (1958), American Security & Trust Company

Wallace R. Brode (1959), Department of State

J. E. Graf (1960), Smithsonian Institution

Sheldon B. Akers (1961), Brookings Institution

Paul A. Scherer, Carnegie Institution of Washington, ex officio

Dael Wolfle, AAAS, ex officio

Hans Nussbaum, AAAS, staff representative

Nominations

Wallace R. Brode (1958), Department of State, chairman

Karl M. Wilbur (1958), Duke University
Clinton L. Baker (1959), Southwestern College, Memphis
Edward F. Degering (1959), 26 Robinhood Road, Natick, Mass.
George R. Harrison (1959), Massachusetts Institute of Technology
Robert Bruce Lindsay (1959), Brown University

Public Information and Science
Paul E. Klopsteg, National Science Foundation, chairman
Roger Adams, University of Illinois
Sidney S. Negus, Medical College of Virginia
Warren Weaver, Rockefeller Foundation
Dael Wolfle, AAAS, ex officio

Publications
Thomas Park (1962), University of Chicago, chairman
Ralph R. Shaw (1958), Rutgers University
Chauncey D. Leake (1959), Ohio State University
George R. Harrison (1960), Massachusetts Institute of Technology
Paul M. Gross (1961), Duke University
Dael Wolfle, AAAS, ex officio
Graham DuShane, AAAS, staff representative

Special Committees

AAAS–Anne Frankel Rosenthal Memorial Award for Cancer Research, Judges
Warren Weaver, Rockefeller Foundation, chairman
Harry S. N. Greene (American Association for Cancer Research), Yale University School of Medicine
G. Burroughs Mider, National Cancer Institute
Richard L. Rosenthal, Richard and Hinda Rosenthal Foundation
C. Chester Stock, Sloan-Kettering Institute for Cancer Research
Harry M. Weaver, American Cancer Society

AAAS–Campbell Award for Vegetable Research, Judges
Louis P. Reitz (AAAS Section O—Agriculture), Agricultural Research Service, Beltsville, Md., chairman
G. J. Haeussler (Entomological Society of America), U.S. Agricultural Research Service, Beltsville
Sterling B. Hendricks (American Society of Plant Physiologists), Plant Industry Station, Beltsville
Iver J. Johnson (American Society of Agronomy), Iowa State College
F. C. Stark, Jr. (American Society for Horticultural Science), University of Maryland
G. Ledyard Stebbins, Jr. (Genetics Society of America), University of California, Davis
E. E. Wilson (American Phytopathological Society), University of California, Davis

Mina Rees, dean of the faculty at Hunter College, New York, is a new member of the AAAS Board of Directors. [Bradford Bachrach]

AAAS–Ida B. Gould Memorial Award for Research on Cardiovascular Problems, Judges
Paul Dudley White, Boston, Mass., chairman
C. Sidney Burwell (Helen Hay Whitney Foundation), Harvard Medical School
Robert P. Glover (American College of Cardiology), Presbyterian Hospital, Philadelphia
Dickinson W. Richards (Life Insurance Medical Research Fund), Bellevue Hospital, New York
Richard L. Rosenthal, Richard and Hinda Rosenthal Foundation
Francis C. Wood (American Heart Association), University of Pennsylvania Hospital
J. Franklin Yeager, National Heart Institute

AAAS Research Grants
Barry Commoner, Washington University, chairman
E. Lowell Kelly, University of Michigan
Hans Nussbaum, AAAS
Laurence H. Snyder, University of Oklahoma
H. Burr Steinbach, University of Chicago
Dael Wolfle, AAAS, staff representative

AAAS Socio-Psychological Prize
Donald P. Ray, George Washington University
Joseph J. Spengler, Duke University
Dael Wolfle, AAAS

Conference on the Marine Sciences, Steering Committee
Mary Sears, Woods Hole Oceanographic Institution, chairman
Gustav Arrhenius, Scripps Institution of Oceanography
John Cushing, Santa Barbara College
Fritz Koczy, University of Miami
Gordon G. Lill, Office of Naval Research, Washington, D.C.
George S. Myers, Stanford University
Roger Revelle, Scripps Institution of Oceanography
Henry M. Stommel, Woods Hole Oceanographic Institution
Lionel A. Walford, U.S. Fish & Wildlife Service, Washington, D.C.

Council Agenda and Resolutions Committee
William A. Wildhack, National Bureau of Standards, chairman
Paul S. Dwyer, University of Michigan
George C. Paffenbarger, National Bureau of Standards
Kenneth C. Spengler, American Meteorological Society, Boston, Mass.

Management and Business Operations
Mark H. Ingraham, University of Wisconsin, chairman
George J. Beal, Rockefeller Foundation (retired)
F. P. H. Siddons, American Security & Trust Company
Paul A. Scherer, Carnegie Institution of Washington, ex officio
Dael Wolfle, AAAS, ex officio

Popular Science Books
Harrison Brown, California Institute of Technology
Barry Commoner, Washington University
E. U. Condon, Washington University
Kirtley F. Mather, Harvard University
Dael Wolfle, AAAS, ex officio

Retirement Plan (must be composed of three staff members)
Dael Wolfle, AAAS, chairman
Hans Nussbaum, AAAS
Raymond L. Taylor, AAAS

Social Aspects of Science
Chauncey D. Leake, Ohio State University, chairman
T. C. Byerly, U.S. Department of Agriculture, Washington, D.C.
Barry Commoner, Washington University
H. Jack Geiger, 11100 Euclid Avenue, Cleveland

Lawrence Kubie, 7½ East 81st Street, New York
Margaret Mead, American Museum of Natural History
Robert K. Merton, Columbia University
Ward Pigman, University of Alabama Medical Center
Stuart A. Rice, Stuart A. Rice Associates, Washington, D.C.
David D. Rutstein, Harvard Medical School
Dael Wolfle, AAAS, ex officio

Source Books in the History of Science
Gregory D. Walcott, Long Island University, chairman
Harlow Shapley, Harvard University
Edmund W. Sinnott, Yale University

Committees To Be Appointed

AAAS Newcomb Cleveland Prize, Judges
AAAS Socio-Psychological Prize, Judges
Theobald Smith Award in the Medical Sciences, Judges

Representatives

AAAS Cooperative Committee on the Teaching of Science and Mathematics (representative of the Board of Directors)
Alfred B. Garrett, Ohio State University

American Standards Association Sectional Committee on Letter Symbols and Abbreviations for Science and Engineering
Irving P. Orens, Newark College of Engineering

Advisory Council on Medical Education
Lowell T. Coggeshall, University of Chicago

American Council on Education
Mark H. Ingraham, University of Wisconsin
John R. Mayor, AAAS

Committee on the Kimber Genetics Award of the National Academy of Sciences
I. Michael Lerner, University of California, Berkeley

Council of National Organizations of the Adult Education Association of the United States
John A. Behnke, Ronald Press Company

Council of Old World Archeology
Richard K. Beardsley, University of Michigan

Instrument Society of America Committee on Research and Development
Jesse W. Beams, University of Virginia

Joint Commission on Mental Illness and Health
Ernst Mayr, Museum of Comparative Zoology, Harvard College

National Conference on FAO
Noble Clark, University of Wisconsin

Science Service Board of Trustees
Karl Lark-Horovitz (1958), Purdue University
William W. Rubey (1959), U.S. Geological Survey, Washington, D.C.
Wallace R. Brode (1960), Department of State

Scientific Manpower Commission
Detlev W. Bronk, Rockefeller Institute for Medical Research
(Wallace R. Brode, alternate)
M. H. Trytten, National Academy of Sciences

U.S. Committee on ISO Technical Committee 37—Terminology
Duane Roller, Harvey Mudd College

U.S. National Commission for UNESCO
I. I. Rabi, Columbia University

AAAS Membership

1) *Changes during 1957*		
New members elected		6,875
Losses		
Deaths	417	
Resignations	1,353	
Dropped for nonpayment of dues	2,096	
Total loss		3,866
Net increase during 1957		3,009
2) *Totals as of 31 December 1957*		
Paid through December 1957		32,618
Paid through March 1958		1,168
Paid through June 1958		13,975
Paid through September 1958		2,715
Life and emeritus members		962
Total in good standing		51,438
In arrears		3,123
		54,561
New for 1958		1,166
Total membership		55,727

Indianapolis Meeting in Retrospect

Raymond L. Taylor

Throughout its long history, the American Association for the Advancement of Science, now in its 110th year, has been concerned not only with the ever increasing number of scientific contributions but also with the impact of science on society. The principal advances of science and its applications have been reported and assessed in *Science* and other AAAS publications. The annual meeting also has reflected the major trends of scientific thought and, directly or indirectly, matters of import in the nation and the world. This was especially apparent at the fourth Indianapolis meeting. The date, 1957, doubtless will be remembered for man's first successfully launched artificial satellites; viewed in perspective, the 124th AAAS meeting, held only a month or two after sputniks I and II, was indicative of the scientific and technological aspects of an eventful year.

In earlier reports it has been noted that no two scientific meetings are ever alike even when sponsored by the same organization or held in the same locale. This is particularly obvious with the diversified annual convention of the Asso-

ciation, for the sectional programs usually vary in symposium subjects from year to year and the pattern of the participating societies is never identical. Early in the year, as the programs took form, it was apparent that they would be of interest to workers in all principal fields of science and that they would be timely—including, for example, "Moving Frontiers of Science II," the mathematics of guided missiles, an outstanding series of symposia on spectroscopy, the sessions of the American Astronomical Society, more unsolved problems in biology, low-level irradiation, the rehabilitation of the mentally ill, psychopharmacology, space medicine, and the latest advances in crime detection. For some years the scientific community and the AAAS have been increasingly concerned about the relatively low number of future scientists and engineers—and the shortage of those who teach them—the quality of their training, and related problems. These, too, were the subjects of thoughtfully planned sessions by the Conference on Scientific Manpower, Section A, the Cooperative Committee, the Academy Conference, Section Q, and the science teaching societies.

The dramatic orbiting of the man-made satellites and the subsequent press treatment, and the extensive local coverage of the meeting itself, brought some of these issues into sharper focus, with the result that school teachers, students at the college and high-school levels, and the general public became much interested in the meeting and in the Annual Exposition of Science and Industry. There were 3684 registrants and at least nine or ten thousand others who came to see the large-scale exhibits, the premier showing of the National Geographic Society's lecture and film, "The *Bounty* and Pitcairn Island," or one or more of the evening sessions. The Eleventh Annual Junior Scientists Assembly, with a program designed especially for science-minded high-school students, filled the large Murat Theatre. Though there were fewer papers than there had been at any AAAS meeting in recent years, attendance at almost every session exceeded the estimates of program chairmen—indeed, a number of session rooms were seriously crowded. The registration totals—registrants came from all parts of the continent and from every state except Wyoming—made this the eighth largest meeting of the 124 the Association has held.

The two sessions of the AAAS Council were well attended. Among the decisions made was approval of a request that the Association sponsor a "parliament of science" in Washington early in 1958 from which might come specific recommendations on the current issues in science and education that confront the nation.

Arrangements for the Meeting

The decision to meet again in Indianapolis, after an interval of 20 years, was made by the AAAS Board of Directors at its June meeting in 1953. It was logical that the Association should again meet in the Midwest, and there was the general desirability of serving the convenience of the membership in a community in which the Association had not met for some time. The physical facilities of Indianapolis for a meeting of 3000 to 4000 had been adequate in 1937.

Those who attend a large scientific meeting, unless they have shared in making some of the arrangements, may not appreciate the amount of planning and work that eventually result in several hundred sessions, most of them requiring one or more types of projection equipment. The cooperation and services of a great many individuals are essential. Usually, an experienced convention bureau will operate a housing bureau and provide registration personnel, but everything else must be arranged by the sponsoring organization. Local committees must set up, preferably in the preceding year.

This has been the pattern of AAAS meetings in the postwar years: Early each spring the secretary of each section and participating society is asked to estimate the probable number of sessions and make his best guess about the probable attendance at each. It is easy to over- or underestimate when, at this stage, the programs are still far from complete and when calls for papers may not yet have gone out. Soon afterward, on the basis of requirements and preferences for session rooms, the headquarters hotels for related sections and societies are selected.

In Indianapolis, the preferences of the science teaching societies and of the American Astronomical Society for the Antlers and Marott hotels, respectively, were logical and were carried out. The dental researchers were based on the campus of the Indiana University Medical Center. To effect as compact a meeting as possible, all other sections and societies were divided among the downtown hotels—the Claypool, Sheraton-Lincoln, Continental, Washington, Severin, and Warren. Related groups of societies and sections, especially when interdisciplinary programs were planned, were assigned to the hotel that could best meet their needs. As in 1937, the Murat Temple was the site of the Annual Exposition of Science and Industry and of the AAAS Science Theatre. Many of the larger and more important sectional programs were held in the Temple and the Murat Theatre, under the same roof. The assignment of particular rooms was made on the basis of the attendance estimates provided by the program chairmen. Some of the Temple's session rooms were less convenient to reach than others. The attendance at many of the sessions exceeded expectations, and some of the rooms, at times, were badly overcrowded. Several of the improvised rooms proved to be unsatisfactory acoustically because the heavy curtaining originally planned was not available. Sincere regret and apologies are expressed to those who were affected. (All sections, but especially those most seriously inconvenienced, are assured that they will have satisfactory facilities this year.)

On the bright side, the complex projection arrangements were unusually well carried out. The local Committee on Physical Arrangements always has one of the most taxing assignments. Usually more than 200 sessions require projection facilities, often of two or more types per session. Lanterns must be assembled, approved as suitable for the size of the room and the session in each case, tagged with respect both to source and session room, transported to the hotels, checked in and out of the storage rooms, repaired, supplied with spare lamps, and the like. Personnel must be engaged both to deliver and to operate the equipment.

In Indianapolis, with very few exceptions, all projection equipment was lent by the city's public schools—with the consent and cooperation of each school principal and of the audio-visual department. The number of lanterns moved into each of the hotels and into the Temple before Christmas—on the last "working day" before the first day of the meeting—was based on the number requested in projection requirement forms that had been returned to the Washington office of the Association by most, but not all, of the program chairmen. Some "extras" were provided in anticipation of last-minute requests for projection. In general, the lanterns were distributed and collected by members of the school faculties, who had volunteered their services. The Committee on Physical Arrangements did a splendid job, and all concerned are deeply indebted to the members and, in particular, to the chairman, Newton G. Sprague, consultant in science and mathematics for the entire Indianapolis school system. Dr. Sprague, who gave much of his time prior to the meeting, was present throughout the five days to direct operations and, subsequently, has supervised the return of all equipment, the payment of operators, and the like. Thanks are also due to the many program chairmen who arranged for volunteer operators from among those in attendance and to the operators themselves. Other operators were carefully selected high-school students, who worked well for moderate remuneration. The services rendered by all were substantial.

Highlights of the Meeting

All AAAS meetings enjoy the presence of an impressive group of top-level investigators and high-ranking research administrators. As noted below, the special sessions, without exception, were memorable events and were well attended. On Friday morning, 27 December, under the auspices of the Biometric Society, Eastern North American Region, Sir Ronald A. Fisher, Arthur Balfour professor of genetics, Cambridge University, spoke on the statistical aspects of smoking and lung cancer. He was critical of conclusions based on other than controlled experiments.

On the evening of 27 December the joint annual address of the Society of the Sigma Xi and the Scientific Research Society of America, "The fickle fashions of science," was delivered by Crawford H. Greenewalt, president of E. I. duPont de Nemours & Company, who received the William Procter prize of RESA. Concurrently, the 18th annual address of the United Chapters of Phi Beta Kappa, "A long search for understanding," was given by Elvin C. Stakman, emeritus chief of the Division of Plant Pathology and Botany, University of Minnesota, and a past president of the Association.

On Sunday afternoon, 29 December, a general session sponsored by the AAAS Committee on the Social Aspects of Science included a series of speakers, who, as individuals, debated the radiation problem; several committee members and Chauncey D. Leake, chairman, were additional panel members during the discussion which followed. The concluding special session, sponsored by the National Geographic Society, was the lecture by Luis Marden of the foreign editorial department of the society. His story was accompanied by a premier showing of his film, "The *Bounty* and Pitcairn Island." The Murat Theatre was filled to capacity (some 2500). Hundreds who had not arrived early enough had to be turned away. This annual lecture and feature of the Association meeting was scheduled early in the evening so that registrants could visit the exhibits and attend the AAAS Smoker in the nearby Social Hall of the Murat Temple.

AAAS Presidential Address and Reception

On the customary evening, 28 December, the traditional address was given by the retiring (109th) president of the Association, Paul B. Sears, before an audience which filled the long ballroom of the Hotel Claypool. Laurence H. Snyder presided and introduced each speaker, with appropriate remarks, A. H. Fiske, vice president of Eli Lilly and Company and general chairman of the fourth Indianapolis meeting, on behalf of the local committees, graciously welcomed the Association and the audience to Indianapolis. President Snyder, after a brief tribute to Sears and a short summary of his distinguished scientific career in botany, ecology, and conservation, introduced him as principal speaker of the evening.

Table 1. Analysis of sessions at the fourth Indianapolis meeting.

Sessions for symposia, invited papers, and panels	96
Sessions for contributed papers	30
Sessions with addresses or lectures	31
Business sessions	36
Meal or social functions	38
Tours and field trips	5
Sessions for motion pictures	14
Total number of sessions	250

Dr. Sear's address, "The inexorable problem of space" [*Science* **127**, 9 (3 Jan. 1958)] provided a memorable experience for those who were present. Well-inflected and well-paced, illuminated with characteristic flashes of humor, it was a thoughtful discussion of the physical limitations of terrestrial space for man's burgeoning populations and concomitant urban and industrial developments. Sears concluded with the statement, "Our future security may depend less upon priority in exploring outer space than upon our wisdom in managing the space in which we live."

The AAAS reception which followed was well attended. The receiving line included members of the platform party and their wives and Thomas Elsa Jones, president of Earlham College, who represented the Honorary Reception Committee. For those in the receiving line, it was a pleasure to greet so many members and friends of the Association.

AAAS General Symposium

The Association's general symposium, "Moving Frontiers of Science II: Ideas that Mold our Work," was held the evening of 26 December in the Claypool's ballroom and the afternoon of the 27th in the Murat Theatre. This symposium, which had been arranged by the Committee on AAAS Meetings, consisted of three addresses outlining major concepts in the behavioral, physical, and biological sciences and a panel discussion in which all speakers and the chairman participated.

In the first session, the address of S. S. Stevens was "Measurement and man"; "Distance and relativity" was the title of the address delivered by G. C. McVittie. The third address, "Evolution at work," was given by T. Dobzhansky. F. S. C. Northrop presided throughout and contributed to the concluding discussion. These addresses will appear in *Science*.

Other Symposia

The trend toward a large number of symposia at AAAS meetings continued, not only among the sections of the Association but also among the participating societies. As Table 1 shows, there were 96 symposia, panels, groups of invited papers, or other sessions centered about a particular theme. There were over three times as many sessions devoted to programs of this type as to sessions for contributed papers, although 14 organizations were holding their national meetings with the Association. As is shown in Table 2, the participating societies, including an *additional* 21 societies which arranged special meetings, in the aggregate had about half as many sessions of this type as the AAAS and the 17 sections with programs. The 580 symposium participants markedly outnumbered the 259 other speakers. Among the 96 symposia, the following were noteworthy for their interdisciplinary scope: "Continental Glaciation and its Geographic Importance as an Environmental Factor," (four sessions), sponsored by AAAS Section E (Geology and Geography), cosponsored by the Association of American Geographers, East Lakes and West Lakes Divisions, and the Geological Society of America, arranged by Frank C. Whitmore, Jr., and Louis L. Ray (U.S. Geological Survey, Washington, D.C.); "Geographic Distribution of Contemporary Organisms," a joint program of AAAS Sections F (Zoological Sciences) and G (Botanical Sciences), cosponsored by the Society of Systematic Zoology, Ecological Society of America, Genetics Society of America, American Society of Naturalists, American Society of Zoologists, and the Botanical Society of America, arranged by Harold H. Plough (Amherst College); "Social Aspects of Urban Agglomeration," a joint program of AAAS Section K (Social and Economic Sciences), the National Academy of Economics and Political Science, and the American Economic Association, with the collaboration of the National Social Science Honor Society Pi Gamma Mu, arranged by Donald P. Ray (National Academy of Economics and Political Science, Washington, D.C.); "Can Science Provide an Ethical Code?" a program sponsored by AAAS Section L (History and Philosophy of Science), cosponsored by AAAS Section Np (Pharmacy) and the Philosophy of Science Association, arranged by Lewis K. Zerby (Michigan State University); "Man and His Environment," a program of AAAS Section

Table 2. Comparison of AAAS-sectional and societal programs.

Items	AAAS, its sections, and conferences	Participating societies	Total number of sessions with papers	Total number of speakers
Sessions for symposia, invited papers, and panels	62 (334 speakers)	34 (246 speakers)	96	580
Sessions for contributed papers	15 (100 papers)	15 (118 papers)	30	218
Sessions for addresses and lectures	14 (18 speakers)	17 (23 speakers)	31	41
Total			157	839

M (Engineering), cosponsored by the American Meteorological Society, the American Industrial Hygiene Association, and the American Geophysical Union, arranged by a committee, Carl F. Kayan (Columbia University) chairman; and "Rehabilitation of the Mentally Ill: Social and Economic Aspects," (four sessions), a program of the American Psychiatric Association, cosponsored by AAAS Section K (Social and Economic Sciences) and the American Sociological Society, arranged by a committee, Milton Greenblatt (Massachusetts Mental Health Center) chairman. The Association expresses its deep appreciation to all who prepared papers for these and the other, more specialized, symposia.

Conferences

All of the three conferences that are held each year at AAAS meetings had programs of two or more sessions. The Academy Conference, composed of the official delegates of the 41 academies of science affiliated with the Association and of others interested in academy affairs, had a day and a half of sessions devoted largely to ways and means of implementing the recommendations of the Chicago Conference on Junior Academies, culminating in a dinner at which Mrs. B. G. Heatwole gave the Academy Conference presidential address.

The program of the Conference on Scientific Manpower, which was arranged by a committee headed by Thomas J. Mills and cosponsored by the Engineering Manpower Commission, the Scientific Manpower Commission, the National Research Council, the National Science Foundation, and AAAS Section M (Engineering) held two sessions devoted to "Scientists and Scientific Research in a Changing Economy."

The Conference on Scientific Editorial Problems (program chairman, George L. Seielstad) had four sessions, two of which were cosponsored by the Society of Technical Writers and Editors; members of this organization contributed to the attendance and participated in the discussions.

AAAS Business Sessions

As required by the constitution, the Association's board of directors held its fourth regular meeting of the year at the annual meeting; as usual, its several sessions preceded the two sessions of the Council (27 and 30 December), which are reported elsewhere. It is gratifying to note that these sessions were well attended. The AAAS section officers' luncheon and business meeting, held on 29 December, was also well attended. There was helpful discussion on the tentative plans for the Washington meeting of 1958.

Attendance

In number of registrants—3684—the fourth Indianapolis meeting was the eighth largest in the 109-year annals of the Association. The paid registrations substantially exceeded the 3094 registrations at the previous Indianapolis meeting of 1937—when a number of large societies held their national meetings with the AAAS. (In number of registrations, the other seven large AAAS meetings have been: New York, 1949—7014; New York, 1956—5327; Chicago, 1947—4940; Washington, 1924—4206; New York, 1928—3925; Berkeley, 1954—3856; and Philadelphia, 1951—3702. To date, only 12 of the 124 AAAS meetings have exceeded 3000 registrants, and five of these have been in the past 8 years.)

It is always true that the *total* attendance of professional scientists, faculty members, other teachers, and graduate students at any national meeting of the Association is much greater than the number of registrations, since all programs and most events are open to every-

Table 3. Distribution of registrants by states and countries.

Alabama	9	North Dakota	2
Arizona	10	Ohio	213
Arkansas	15	Oklahoma	21
California	50	Oregon	4
Colorado	9	Pennsylvania	104
Connecticut	25	Rhode Island	6
Delaware	7	South Carolina	3
District of Columbia	84	South Dakota	5
Florida	26	Tennessee	52
Georgia	11	Texas	28
Illinois	280	Utah	4
Indiana		Vermont	6
Indianapolis	1058	Virginia	39
Other*	691	Washington	4
Iowa	48	Wisconsin	53
Kansas	40	West Virginia	11
Kentucky	73		
Louisiana	13	Total, continental U.S.	3641
Maine	5		
Maryland	57	Alaska	1
Massachusetts	68	Australia	1
Michigan	163	Canada	31
Minnesota	31	England	1
Mississippi	9	India	2
Missouri	61	Lebanon	1
Montana	2	Mexico	1
Nebraska	21	Puerto Rico	1
Nevada	1	Switzerland	1
New Hampshire	2	Thailand	3
New Jersey	52		
New Mexico	9	Total, territorial and foreign	43
New York	140		
North Carolina	16	Total registration	3684

* 116 other communities, large and small, academic and industrial.

one. Professional scientists and teachers register nearly 100 per cent, unless their societies have a separate registration; in these instances, many regard a "double registration" as superfluous or onerous. Finally, there are usually several thousands of the science-minded general public who attend the evening lectures or some one event who do not register at all. At Indianapolis it is probable that an additional 10,000 attended one or more of the 250 sessions or visited the Annual Exposition of Science and Industry, at which 75 exhibitors filled 94 booths.

As Table 3 shows, about 29 percent of the total registrants came from Indianapolis. The remaining 71 percent were from out-of-town—from 116 other Indiana communities, from every state in the nation (with the sole exception of Wyoming), from the District of Columbia, and from Canada. There were 43 scientists who represented ten other countries and territories; most, if not all, of these were visiting scholars at American institutions.

The volume of registrations is particularly impressive when it is borne in mind that none of the larger societies was meeting with the AAAS in 1957 and that Section H had cancelled its program plans in view of the fact that sessions of the American Anthropological Association were being held in Chicago during the same week.

The large attendance from so many geographical sources and the excellent representation at programs of each of the sections (with the exception of anthropology) again demonstrated that, when programs of the symposium type are well chosen with respect to subject and are of high quality, a gratifying number of scientists and members of societies not meeting with the AAAS will travel long distances to attend them.

On the other hand, although the Association, its 18 sections, and its conferences can ensure a good-sized convention, at least in a large metropolitan center, it is clear that the participating societies do contribute a substantial and desirable "core attendance" and a welcome additional diversity of interest. At the fourth Indianapolis meeting, 14 organizations participated with annual national meetings—the AAAS Cooperative Committee on the teaching of Science and Mathematics, the Academy Conference, the American Astronomical Society, American Nature Study Society, Beta Beta Beta Biological Society, Biometric Society ENAR, Conference on Scientific Editorial Problems, Conference on Scientific Manpower, National Association of Biology Teachers, Society for General Systems Research, Scientific Research Society of America, Sigma Delta Epsilon, Society of the Sigma Xi, and the Society of Systematic Zoology. Twenty-one other societies arranged special or regional meetings—notably the Ecological Society of America and the American Psychiatric Association, with four sessions and a four-session symposium, respectively. Finally, an additional 37 societies and organizations were the formal cosponsors of appropriate programs of sections or of other societies.

Table 4 shows the 3684 registrants analyzed by subject fields, except for 193 instances where this line on the registration slip was left blank and where no other clues were available. In this analysis, every effort was made to record each individual's primary interest; high-school science teachers who indicated their major interest as teaching or science education were not classified as biologists or chemists, and so on. If the data on the different disciplines are grouped under still broader headings, the composition of the registered attendance was as follows:

Physical sciences and applications	1024	28%
Biological sciences and agriculture	790	21%
Medical sciences	523	14%
Psychology, other social sciences	259	7%
Science teaching and education	326	9%
General interest and other	762	21%
	3684	

By comparison with comparable percentages at AAAS meetings of previous years, attendance in the physical sciences was higher, in the biological and medical sciences, somewhat lower, and in science teaching, the same, and those registrants who indicated a *general* interest in science were about twice as numerous as in previous years. The number of biologists and medical researchers was gratifyingly high when all circumstances of locale and society participation are considered. The increase in the percentage of registrants in the general-interest category, a number of whom were teachers and students, can be attributed in part to the excellent local coverage of the meeting but primarily, it is believed, to a rapidly growing general realization of the importance of science today.

As pointed out in a recent editorial [*Science* **126**, 1157 (6 Dec. 1957)], exhibitors of the books, instruments, and laboratory supplies which scientists and teachers use have an understandable interest in the composition of the attendance at AAAS meetings. From the foregoing data—and also in view of the fact that so many of the registrants were department heads, directors of research, and others in a position to decide on textbooks and other materials—it is apparent that a AAAS meeting, diversified as it is, is well worth the participation of those who produce the things scientists need and that, collectively, the meeting also provides an exceptional opportunity for large industries to show some of their technological accomplishments.

Annual Exposition of Science and Industry

The 1957 Annual Exposition of Science and Industry filled the Egyptian Room on the second floor of the Murat Temple. The always popular AAAS Science Theatre was located on the stage at the far end of the exhibit area. The Visible Directory of Registrants was located in the foyer at the entrance to the exhibits. These arrangements were made for the maximum convenience of visitors to these several features and of those attending sessions in the same building.

The local Committee on Exhibits, headed by Edward B. Newill, (vice president, General Motors, and general manager, Allison Division), with Roger Fleming as secretary, did an outstanding job in enlisting the interest and support of

Table 4. Registrants by subject fields.

Mathematics and computers	89
Physical sciences	
Physics	171
Meteorology	5
Electronics	24
Astronomy	190
Chemistry	268
Geology and geography	178
Engineering and industrial science	99
Biological sciences	
Biometry and statistics	20
Ecology	79
Botanical sciences	104
Zoological sciences	217
Microbiology	30
Biology (in general, and other)	287
Agricultural sciences, including entomology	53
Medical sciences	
Bacteriology	13
Biochemistry, including nutrition	75
Clinical chemistry	19
Dermatology	35
Physiology and space medicine	39
Dental research	42
Pharmacology and pharmacy	136
Medicine, in general and other	164
Social and economic sciences	
Mental health	37
Other (including criminology, economics)	66
Psychology	101
History and philosophy of science	32
Scientific editorial problems	23
Science teaching and education	326
Students	352
Interest in three or more sciences	217
No field indicated	193
Total	3684

large firms in Indiana. The displays of jet engines, components and adjuncts of missiles, and other electronic devices and demonstrations of the research activities of the large pharmaceutical companies helped to make the 1957 Exposition well "worth a trip to Indianapolis for itself alone." A grateful acknowledgment of the work of the Exhibits Committee is made on behalf of the Association and of all who enjoyed these exhibits.

The names of most of the 75 exhibitors and descriptions of their exhibits have appeared both in the General Program-Directory and in the preconvention issue of *Science*. An additional commercial exhibitor was *Encyclopaedia Britannica*.

The exhibitors of the fourth Indianapolis meeting, in their answers to a questionnaire, have already expressed their satisfaction over the contacts made; some have already indicated their intention of participating in the 1958 Exposition, which will be located in the exhibit hall of the Sheraton-Park Hotel, Washington, D.C.

AAAS Science Theatre

The Science Theatre, which shows a selection of the latest foreign and domestic scientific films, was inaugurated at the Chicago meeting of 1947. It is now an established feature of the annual meetings of the Association. For the seven programs given during the week, the 250 chairs were well filled by ever-changing audiences. Many came to see a particular film and stayed for several more. Each of the 30 different films listed in the General Program-Directory was shown twice, and a few were shown three times. The Association again expresses its appreciation to those who so kindly lent such excellent films.

Work of the Local Committees

A scientific meeting as large and as complex as the annual meeting of the AAAS does not just happen. It cannot take place, nor can it succeed, without the cooperation and assistance of a great many agencies and persons. Of critical importance among these are the local committees and the general chairman who appointed them. The Association and all who attended the fourth Indianapolis meeting are much indebted to A. H. Fiske, vice president of Eli Lilly and Company, who made distinguished appointments to the local committees, kept in close touch with all phases of the meeting, and graciously welcomed members and friends of the Association the evening of 28 December. On behalf of the Association, a grateful acknowledgment of the extent of our indebtedness to Dr. Fiske is made here.

The able work of the Committee on Physical Arrangements and of the Committee on Exhibits has already been acknowledged. The Association is also indebted to the local Advisory Committee (H. T. Pritchard, chairman of the board of Indianapolis Power & Light Company, chairman) and to the Housing Committee (William A. Atkins, president of the Severin Hotel Company, chairman) for their very helpful services.

The Committee on Public Information (headed by James W. Carr, executive secretary of the James Whitcomb Riley Memorial Association) provided expert advice and assistance in publicizing the meeting locally. Premeeting announcements in the press are not readily secured (probably on the principle that a meeting is not news until it happens), but the local scientific societies, and the local press, radio, and television in Indianapolis did provide an exceptional amount of advance and current information on the meeting. The Association expresses its grateful appreciation. Additional details on this, and on the national coverage during the meeting, will be found in the report by Sidney S. Negus in this issue.

The Association acknowledges with deep appreciation the work of the Finance Committee, which, through its able chairman, Joseph E. Cain (president of P. R. Mallory & Company, Inc.), has solicited funds to reduce the deficit of the meeting. It is anticipated that when all replies are in, the deficit will have been resolved. Firms and individuals who have made contributions to date include:

American Fletcher National Bank and Trust Co.
Hugh J. Baker and Company
Borg-Warner Corporation, Atkins Saw Division
W. R. Borinstein
Bridgeport Brass Company
Challenge Machine & Tool Company, Inc.
George B. Elliott
Engineering Metal Products Corporation
B. M. Fairbanks
Fidelity Bank & Trust Company
Hoffman Specialty Manufacturing Corporation
Indiana Bell Telephone Company
Indiana National Bank
Indianapolis Power & Light Company
Indianapolis Water Company
Jones & Laughlin, Steel Warehouse Division
LeTourneau-Westinghouse Company, Adams Division
Lilly Varnish Company
Link-Belt Company
Merchants National Bank & Trust Company
Peoples Bank & Trust Company
Ransburg Electro Coating Corporation
Howard W. Sams & Co., Inc.
Stark, Wetzel & Co.
Thomson & McKinnon

To these should be added a contribution made for a fifth time by the United-Carr Fastener Corporation of Cambridge, Massachusetts, to the AAAS for any worthy purpose and applied to the fourth Indianapolis meeting.

Other Acknowledgments

At the AAAS Smoker, as in past years, the Coca-Cola Company, through the Coca-Cola Bottling Company of Indianapolis, the National Biscuit Company, and Philip Morris, Inc., donated their products. The Association gratefully acknowledges these generous and recurrent donations.

In concluding this report of the 124th meeting, besides thanking all members of the local committees, I would like to express my personal appreciation to Joseph J. Cripe (manager), Dean H. Phillips (assistant manager), Mrs. Grace Schulmeyer (manager of the housing department), and others of the staff of the Indianapolis Convention Bureau, who supplied expert professional assistance and friendly help throughout; to the managements and sales managers of the Claypool, Sheraton-Lincoln, Antlers, and other hotels for their many courtesies and great assistance; and to the secretaries and program chairmen of each section and participating organization for their able cooperation, especially with reference to copy and galley proof for the 340-page General Program-Directory.

Awards and Prize Winners

The following annual awards were made during the meeting: 30th AAAS Newcomb Cleveland prize to Martin Schwarzchild and J. B. Rogerson, Jr., Princeton University Observatory, and to J. W. Evans, executive director, Sacramento Peak Observatory [*Science* **127**, 138 (1958)]; 13th Theobald Smith Award in the Medical Sciences to Paul Talalay, associate professor, Ben May Laboratory for Cancer Research, University of Chicago [*Science* **126**, 1334 (1957)]; 3rd AAAS-Anne Frankel Memorial Award for Cancer Research, to Roy Hertz, chief, Endocrinology Branch, National Cancer Institute [*Science* **127**, 21 (1958)]; 1st AAAS-Campbell Award for Vegetable Research, to S. H. Wittwer and F. G. Teubner, department of horticulture, Michigan State University [*Science* **127**, 76 (1958)]; 2nd AAAS-Ida B. Gould Memorial Award for Research on Cardiovascular Problems, to Irvine H. Page, head of the Research Division, Cleveland Clinic [*Science* **127**, 183 (1958)]; and the 4th AAAS-Socio-Psychological Prize, to Irving A. Taylor, assistant professor of psychology, Pratt Institute [*Science* **127**, 183 (1958)].

Public Information Service

Sidney S. Negus

Last spring, James W. Carr, executive secretary of the James Whitcomb Riley Memorial Association, was invited to be chairman of the local committee on public information for the Indianapolis meeting. Fortunately for the Association, he accepted this invitation. The members of the Indianapolis Public Relations Society became a committee of 36 communication experts to help him set the stage locally for this complex operation. Another fortunate happening soon occurred. Joseph E. Palmer, field secretary of the James Whitcomb Riley Memorial Association, agreed to help arrange all radio and television programs for the meeting. This team of 40, including my secretary, Lillian A. Hughes, and myself, went into action in mid-September after various preliminaries had been cleared during the summer months. This early start was possible because information needed by us in Richmond came through so quickly from Mr. Carr and his group.

Preliminary announcements of the meeting were sent out widely early in the fall to newspapers, broadcasting stations, scientific journals, trade journals, and high school and college weeklies. School principals in Indiana, editors of Chambers of Commerce publications, heads of scientific and civic organizations in Indianapolis, AAAS members in the area, and others were asked to help in letting midwestern folks know that the 124th meeting of the AAAS was to be in their territory during the last week of December. Never before in my 20 years with this department has one of its annual conventions had such favorable and widespread premeeting publicity—thanks to friends of the Association in Indiana.

Secretaries and program chairmen of the 17 AAAS sections meeting in Indianapolis and those of the 75 participating societies and officers of the Association cooperated splendidly with us. At the same time that titles of papers and the names of their authors were sent to Raymond L. Taylor for inclusion in the General Program-Directory, duplicate copies were forwarded to this department. Thus, we were able to write to practically all of the 900 authors on the program before mid-November requesting abstracts or complete copies of their contributions, or both. Approximately 300 personal letters were written to authors whose papers, as judged by their titles, appeared to be especially newsworthy. We did not experience quite as good cooperation from those who were presenting papers at the meeting as we have had at many meetings in the past. Consequently, we were unable to meet some requests on the part of science writers for scientific reports which they considered newsworthy.

As soon as all of the material for the General Program-Directory had been sent to the printer, it was possible to prepare a geographical index of all authors on the program. This was done by Jacquelyn Vollmer of the AAAS headquarters staff. Copies of this 40-page index were sent well in advance of the meeting to news bureaus of all colleges, industries, and governmental agencies (210) having representatives presenting papers. Copies were also sent to city editors of newspapers in towns and cities where authors resided (121) and to science writers (95) from different parts of the country who had registered previously to report the meeting. Thus, we invited over 400 individuals to report the papers of their "home town" scientists.

One hundred and forty-three accredited representatives of the press, radio, and television registered in the press room at Indianapolis. Milton Silverman, science editor of the *San Francisco Chronicle* and president of the National Association of Science Writers, traveled the farthest to cover the meeting and was more or less duly rewarded with the press-room medal. Sixty-one other individuals in the United States and abroad reported the meeting from nontechnical abstracts and from complete papers mailed to them before and during the convention. All American and several foreign wire services, many leading newspapers, scientific journals, and news magazines were represented at the meeting.

Everyone in attendance was greatly impressed with the excellent coverage given the convention by the three Indianapolis newspapers. For this, the Association is grateful to managing editors Eugene S. Pulliam of the *News*, Robert P. Early of the *Star*, and J. B. Stephens of the *Times*. They and their city editors and reporters did a marvelous job of informing the general public of the Midwest what was going on in Indianapolis during this "Science Week in Indiana." This proclamation by Governor Handley was especially appreciated as was the personal support of the meeting by Mayor Bayt of Indianapolis.

News stories and wire pictures concerning the meeting must have been published widely outside Indianapolis because clippings from many publications in this country and abroad have been brought to our attention. Close to 60,000 words were filed by reporters with Western Union during the week. Those filed by the wire services and broadcasting stations with their own facilities must have brought the wordage to well over 100,000. Feature stories, not requiring close deadlines, are beginning to appear in various publications. Several representatives of magazines registered in the press room solely to get ideas for future articles.

Joseph E. Palmer, who was in charge of arranging radio and television programs before, during and after the meeting, turned in one of the best jobs ever for the Association. All local stations cooperated so fully that it would be impossible to list the programs aired. Many talks were taped by the Voice of America; the educational station at Butler University (WAJC) carried five full speeches of prominent scientists; each of the commercial stations (WFBM, WLW-I, WISH, WIRE, WIBC, and WTTV) aired programs and spot news many times daily; and much news about the meeting was radioed nationally. There was little, however, in the way of national television coverage.

William H. Book, executive vice president of the Indianapolis Chamber of Commerce, arranged (in cooperation with Mrs. Fred Willkie and this department) a meeting of 250 selected high school science students with nine leading scientists in different fields. This unique get-together was held at the Herron Art Institute on December 29 and was most successful. The scientists (Drs. Bean, Birge, Brode, Brues, DuShane, Sears, Snyder, Wolfle, and Major Simons) talked with groups of students about their future careers in science. Many complimentary letters have been received from the students who attended this "party." It is reported here because the consensus appears to be that such a gathering should be made a part of the Association's program at each of its annual meetings.

For assistance in the press room at Indianapolis, we are grateful to the Indiana University Medical Center for furnishing a desk and filing cabinets; to the

Dr. Negus, who is director of the AAAS Public Information Service, is chairman of the department of biochemistry at the Medical College of Virginia, Richmond.

Indiana Bell Telephone Company for contributing the services of Marjorie N. Pierce as a secretary; to Dorothy Nisely of the Indianapolis Public Library for volunteering as a communications specialist; to Maurice C. Gronendyke of the Indiana State Chamber of Commerce and Charles E. Ehlers of the Claypool Hotel for helping to provide ideal working facilities in the Florentine Room; to Robert Worth and Joseph Sitzman, Eagle Scouts of the Central Indiana Council, Boy Scouts of America, for serving as messengers; to the Indianapolis Press Club for extending guest privileges to out-of-town science writers; to the Florida Citrus Commission and Noyes and Sproul, Inc., for the hospitable serving of fresh orange juice continuously each day; to the General Electric Company Research Laboratory for holding open house each evening for all reporters covering the meeting; to D. H. Radler of the Purdue Research Foundation and Hugh Hazelrigg of the Indiana University News Bureau for helping in many ways to make visiting science writers feel at home in Indianapolis; to Reverend Laurence T. Hosie, executive secretary of the Church Federation of Greater Indianapolis, for making arrangements for the Protestant interdenominational service at the Roberts Park Methodist Church on Sunday, 29 December; to Eli Lilly and Company for the reception for reporters at the Severin Hotel on the evening of 27 December; to the Allison Division of the General Motors Corporation for the press reception the following evening; to Herman B Wells and Frederick L. Hovde, presidents of Indiana University and Purdue University, respectively, for entertaining science writers and their wives at dinner at the Athenaeum on 28 December following the semiannual meeting of the National Association of Science Writers; to the Indianapolis Chamber of Commerce, Pitman-Moore Company, American Tobacco Company Research Laboratory, Indianapolis Power and Light Company, James Whitcomb Riley Memorial Association; and the Indiana University Medical Center for providing luncheons for the press during the meeting; and to the "old-timers" of the NASW for invaluable technical advice.

Thelma C. Heatwole of Staunton, Virginia, was press room director. After this experience for six consecutive annual meetings of the Association, her services have become invaluable. Wayne Taylor of Austin, Texas, was again the press room photographer, and Foley F. Smith of Richmond, Virginia, served as an associate. James W. Carr and Joseph E. Palmer made their headquarters with us. These individuals and the secretaries mentioned previously arranged 18 press conferences during the week and got source material quickly to reporters to whom, more than to any others, goes the credit for helping to make possible at these annual meetings one of the four principal objectives of the AAAS: to increase public understanding and appreciation of the importance and promise of the methods of science in human progress. The Association is deeply appreciative of the world-wide coverage of its meetings by members of the National Association of Science Writers and other representatives of the Fourth Estate.

Reports of Sections and Societies

Mathematics (Section A)

Section A presented a program of three invited papers on the mathematics of guided missiles on Saturday morning. A. George Carlton of the Johns Hopkins Applied Physics Laboratory outlined a solution to the problem of filtering radio noise in missile guidance. Homer E. Newell, Jr., of the U.S. Naval Research Laboratory gave a popular exposition of satellite orbits. Robert W. Rector of the Ramo-Wooldridge Corporation gave an over-all picture of the American effort in guided missiles.

On Thursday afternoon, two former chairmen of the section gave their retiring addresses. Dean Mina Rees of Hunter College spoke of the various professional opportunities for mathematicians other than in teaching. A. W. Tucker of Princeton University explained a new method in mathematical programming.

On Friday morning the section was cosponsor, with the National Council of Teachers of Mathematics and with the AAAS Cooperative Committee on the Teaching of Science and Mathematics, of a program on the modernization of the mathematics curricula in schools and colleges. In the afternoon Section A and the National Council listened to invited papers on curriculum study.

C. C. MacDuffee, *Secretary*

Symposium on Mathematics Instruction. The symposium on mathematics instruction was planned to bring before the scientific community information on current curriculum studies and a statement on the mathematics curriculum in perspective.

R. L. Davis, executive secretary, reported for the Mathematical Association's Committee on the Undergraduate Program (CUP). Davis indicated that CUP was concerned with ways to (i) bring to college freshmen the calculus which underlies so many of the important applications, (ii) introduce to them the set notions and probability theory basic to so many modern applications, and yet (iii) do all this without making unrealistic demands on students with 2½ years of high school mathematics.

The Committee on the Undergraduate Program has tried to answer these questions by designing and producing whole courses which would accomplish these ends, by sponsoring mathematical expositions for teachers and students, and by studying the design of special courses for teachers. The committee has also designed two types of sophomore courses. One course, for physical science and engineering majors, will save student time because it provides a head start from the first-year course and with further gains in the use of handbooks and tables. The emphasis of the whole course will be shifted to a consistent use of vectors and differential forms in many-variable calculus. The other course for sophomores answers increasing demands from biological and social scientists, covering at first the elements of many-variable calculus and linear algebra. There are also special units on optimum problems and linear programming, probability theory, Markov chains, order relations, and finally, a long unit on mathematical models in the biological and social sciences.

A. W. Tucker reported for the Commission on Mathematics. The College Entrance Examination Board established

the commission, with Tucker as chairman, to consider broadly the secondary school college-preparatory mathematics curriculum and to make recommendations looking toward its modernization, modification and improvement. Likely proposals include: (i) more emphasis on deductive reasoning in algebra and less in geometry; (ii) introduction of coordinates and vectors in plane geometry and trigonometry; (iii) combining concepts with skills to give deeper understanding; (iv) some use of simplifying abstractions-sets, binary operations, relations, functions, and so forth; (v) introductory probability and statistical reasoning as a desirable replacement for formal solid geometry. The commission recommends that a full secondary program lead to calculus in the freshman year of college and that calculus should be taught in high school only as a college-level course for advanced placement.

The Project for the Improvement of School Mathematics of the University of Illinois Committee on School Mathematics was reviewed by Max Beberman, director of the project. This joint venture of the Illinois Colleges of Education and Engineering and the mathematics department is planned to create a four-year program in college-preparatory mathematics which treats mathematics in the manner of contemporary mathematics and which stimulates interest among young people in the continued study of mathematics. The committee has initiated its program in a dozen schools in Illinois, Massachusetts, and Missouri. Teachers receive instruction from the UICSM in conferences on the Illinois campus, during visits to their schools by coordinators, and through textbooks for teachers and students. Textbooks for four years of mathematics include the distinction between numbers and their symbols; the relations of equality and inequality; algebraic manipulations based on generalizations of arithmetic; graphing equations and inequalities; a postulational development of Euclidean geometry involving considerable work with elementary set theory; the ideas of a deductive theory in which models are constructed for various sets of postulates; mathematical induction; exponents and logarithms; complex numbers; integral rational functions; polynomial equations; circular functions.

C. C. MacDuffee of the University of Wisconsin pointed out that the teaching of mathematics is an experimental science and that drastic changes in curriculum or in methods of presentation should not be made on a large scale until they have been thoroughly tested with small groups. He emphasized that it is important that we teach those whose aim is application as well as those who wish to become pure mathematicians. The development of mathematical intuition was identified as the common objective of all teachers of mathematics, regardless of how their students hope to use it. MacDuffee stated that real reform in the teaching of mathematics in the high school must begin with the teacher and that more persons of excellent ability and training must be induced to join the profession. From such material, he said, teachers can be produced whose understanding of mathematics will be such that the success which others have had in experimental programs with small groups can be made universal.

JOHN R. MAYOR, *AAAS*

Physics (Section B)

A symposium on spectroscopy highlighted the meeting of Section B. Organized by K. W. Meissner, the day-and-a-half symposium covered the following topics: spectroscopy and quantum electrodynamics, primary and secondary wavelength standards, solar spectra, isotope shifts, electronic states of diatomic molecules, spectroscopy of the rare earths, and the role played by spectroscopy in thermonuclear research.

The vice-presidential address was given by William T. Meggers at a banquet which was jointly sponsored by Sigma Pi Sigma and Section B. The address, which was entitled "Reminiscences in spectroscopy," proved to be entertaining as well as instructive, and many of spectroscopy's great names took on added luster. Raymond T. Birge, current chairman of Section B, presided.

Papers on neutrino physics by Frederick Reines, on solid-state physics by Park Miller, and on high-temperature plasmas by Alan Kolb were given in a session devoted to recent advances in physics. Besides the intrinsic value of the individual papers, the session was impressive in showing that research in physics is making a vigorous advance on many fronts.

J. H. MCMILLEN, *Secretary*

Chemistry (Section C)

The programs of Section C featured a session on submitted papers, two sessions on the chemistry of acetylene, and two sessions on pyridine and its derivatives.

The contributed papers included: "The acetylation of imides with ketene," by R. E. Dunbar and Wayne M. Swenson; "Reaction studies of acid halides and ethers," by R. E. Dunbar and Vernon L. Guyer; "The preparation and properties of *t*-alkyl formates," by David W. Young and Eileen Paré; "Enzyme pacemakers, a new concept on the chemical composition and activation of pepsinogen, chymotrypsinogen, and trypsinogen," by Anwar A. Hakim; "Conductance measurement of some salts in anhydrous ethanolamine," by F. C. Schmidt, W. B. Schaap, and P. W. Brewster; "The adrenal response to alcohol intoxication in rats maintained on diets deficient in tryptophan-niacin or in lysine," by J. C. Forbes and G. M. Duncan; and "The nitration of 3-phenylquinoline," by Christian E. Kaslow and Bernard Buchner.

The symposium on acetylene covered the history and current status of acetylene. The following papers were presented: "Commercial acetylene production," by C. K. McLane; "The chemistry of acetylene," by George F. Hennion; "Acetylene derivatives as hydrochloric acid corrosion inhibitors," by R. F. Monroe; "Agricultural uses of acetylene derivatives," by Fred J. Lowes; "A review of the pharmacology of acetylene compounds," by William R. Gibson; "The stereochemistry of nucleophilic additions to acetylene," by W. E. Truce, M. M. Boudakian, J. A. Simms, R. F. Heine, and R. Kassinger; "The acetylene-allene rearrangement," by Thomas L. Jacobs; and "Acetylene in the synthesis of pyridines," by W. R. Wheeler and F. A. Karnatz.

The current status of the chemistry of pyridine was covered in papers such as: "Recovery of pyridine from coal products," by J. H. Wells; "The chemistry of vinylypyridines," by Robert Levine; "Derivatives of vinylpyridine," by Allan P. Gray; "Pyridine-metal salt complexes for clathration separation of aromatic isomers," by W. D. Schaeffer, W. S. Dorsey, D. A. Skinner, and C. G. Christian; "The synthesis and reactions of sterically hindered pyridine bases," by Harold Podall; "Chemistry of pyridine-N-oxide," by E. C. Taylor, Jr.; "Preparation of the pyridolacetones and the inductive effect of nitrogen on the dehydration of the intermediate aldols," by John K. Stille; "Pyrophthalones derived from picolines as intermediates for medicinal agents," by C. H. Tilford, G. L. Krueger, E. D. Amstutz, D. G. Manly, A. Richardson, Jr., and A. M. Stock; and "The chemistry of picolines," by F. E. Cislak.

The next meeting of Section C will be held in Washington, D.C., during the last week of December. Tentatively, it is planned to have one or more sessions of submitted papers, and two series of symposia; one on irradiation and one on free radicals. Now is the time to begin to plan for attending this meeting. Contributed papers should be sent to Dr F. O. Rice or to Ed. F. Degering, Secretary, Section C, 26 Robinhood Road. Natick, Mass.

ED. F. DEGERING, *Secretary*

American Association of Clinical Chemists (C1)

The American Association of Clinical Chemists held two scientific sessions at which 16 scientific reports dealing with several aspects of clinical chemistry were presented. Donald E. Bowman, of Indiana University School of Medicine, and Oliver H. Gaebler, of the Edsel B. Ford Institute for Medical Research, presided at these sessions.

A third and very popular session of the clinical chemists was a half-day symposium entitled "Significant Trends in the Chemistry of Disease." At this symposium Harry Weisberg discussed "Electrolytes and acid-base balance," Jack R. Leonards pointed out some of the "Chemical changes involved in the use of artificial organs," Ralph I. Dorfman presented "Recent advances in the understanding of hormonal factors in disease," and Clarence Cohn discussed the "Use of serum transaminase activities in clinical biochemistry."

A clinical chemists' banquet, which was attended by the majority of the clinical chemists at Indianapolis, was held during the meetings. Albert Sobel discussed his views on "Professional research." This was truly a national meeting of clinical chemists, with participants from New York to California.

ROBERT R. SMEBY, ALFRED H. FREE,
Program Chairmen

Astronomy (Section D)

For the second consecutive year Section D had a joint program with the American Astronomical Society. There were 36 contributed papers on the program, one of which ("Solar photographs from 80,000 feet," by Martin Schwarzschild, J. B. Rogerson, Jr., and J. W. Evans) won the $1000 Newcomb Cleveland Prize. There was also a symposium entitled "The Cepheid Variable Stars."

The Helen B. Warner lecture of the American Astronomical Society was given by Allan R. Sandage (Mount Wilson and Palomar Observatories), on the subject of "Unsolved problems in the quest for the extragalactic distance scale."

All of the sessions for papers were held at Butler University. The symposium and the Warner lecture were held in the World War Memorial Auditorium.

The AAS–Section D dinner was held at the Marott Hotel. Following the dinner Pieter van de Kamp gave the address of the retiring chairman of Section D on the subject of "Facets of astronomy."

FRANK K. EDMONDSON, *Secretary*

Astronomical League (D2)

The program of the Astronomical League was given in the spirit of a public service. As amateur astronomers, most of our members are professionally active in other fields. Therefore no attempt is made to compete with professional astronomers; instead, we confine our activities to maintaining a close relationship with them and their work, in order to satisfy our own thirst for knowledge and to pass it on to the public in general. Through our local societies we provide a platform to introduce astronomy to anyone who is interested. In our junior activities we provide a stimulus to interest juniors in astronomy and give them an opportunity to be active in it and in science in general.

The timing device introduced in the first paper, "An accurate timing device for astronomical observations," was original with the local Indianapolis group and was developed to be used in the local Moonwatch station. It was unfortunate that the paper on "Observations on the Moon" could not be given; the author was not able to be with us at the meeting. Since the author is an authority on this subject, his paper was to have been the highlight of the meeting.

Our junior program is always a surprise to those who are not familiar with the enthusiasm the juniors display. Though only juniors from Indiana participated, the quality and subject matter of the papers was indicative of their devotion to and interest in science. We were delighted with the interest displayed by an audience of about 200 and with the publicity given to this program by the local newspapers and with the television coverage.

The activities of both the junior and senior groups are worthy of public support and are an important stimulus in creating interest in science and in keeping the public informed. For this we need the help of professional astronomers in keeping us informed, and we hope we shall always have a close relationship with them in our common interest, astronomy.

WILHELM GARNATZ,
Program Chairman

Geology and Geography (Section E)

Three symposia were held as part of the Section E program. Attendance ranged from 50 to 300. The symposium on "Continental Glaciation and its Geographic Importance as an Environmental Factor" lasted for 2 days and included 22 papers. Chairmen of the half-day sessions were William D. Thornbury (Indiana University); George W. White (University of Illinois), Paul B. Sears (Yale University), and Louis L. Ray (U.S. Geological Survey). There was a 1-day symposium on Mississippian and Pennsylvanian rocks of the Midwest, with Henry H. Gray (Indiana Geological Survey) and David H. Swann (Illinois Geological Survey) presiding. Nineteen papers were presented. This symposium was a joint session with the Geological Society of America and the Association of American Geographers. A half-day session, joint with the National Speleological Society and the Geological Society of America, was devoted to "Karst Phenomena." William E. Davies presided, and five papers were presented. In addition to the symposia, a half-day session was held consisting of eight contributed papers in geology and geography.

The vice-presidential address by Paul F. Kerr, entitled "Uranium emplacement in the Colorado Plateau," was presented at the Section E smoker. The smoker was arranged by Claude M. Roberts (U.S. Geological Survey) and was sponsored by the Indianapolis Water Company, Layne-Northern Company, and Mobile Drilling and Engineering Company.

The program of Section E emphasized subjects of interest to earth scientists working in the Middle West. In the symposium on continental glaciation, particular emphasis was placed on the contribution that can be made to our studies of glaciation by fields other than geology and geography. This symposium included papers in the fields of climatology, botany, and zoology.

FRANK C. WHITMORE, JR., *Secretary*

National Speleological Society (E4)

Three sessions were sponsored by the National Speleological Society: a general session for contributed papers and two symposia.

Two papers in the general session dealt with regional, rather than local, development of limestone caves. These papers are indicative of the transition from the purely descriptive to the more theoretical phases of American speleology. J. R. Fisher and W. B. White discussed the morphology and origin of a series of small caves in the Van Port limestone (Pennsylvanian) of the Allegheny Plateau northwest of Pittsburgh, and Richard L. Powell presented a summary of investigations on caverns and karst features in the Mississippian and Silurian rocks of southern Indiana. The structure and possible mode of origin of mud stalactites and stalagmites observed in Elrod Cave, Orange County, Indiana, was the subject of a paper by Reuben Vig. The final paper, given by Thomas

C. Barr, was concerned with the invertebrate fauna of Carlsbad Caverns, Eddy County, New Mexico.

A symposium on the cave fauna of the Ohio River valley, arranged by Thomas C. Barr, served to focus attention on recent developments in the systematics of cavernicolous invertebrates in southern Indiana, central Kentucky and Tennessee, and northern Alabama. [The first attempt at a comprehensive treatment of the cave fauna of this region stemmed indirectly from the first Indianapolis meeting of the AAAS, which was held in August 1871. Among those at that meeting who accepted the invitation of the Louisville and Nashville Railroad to visit Mammoth Cave, was A. S. Packard, Jr., whose subsequent interest in biospeleology led him to publish 21 papers on cave animals, culminating in "The Cave Fauna of North America" *Mem. Natl. Acad. Sci. U.S. No.* 1 (1886)]. Groups treated in the symposium were (i) opilionids (C. J. Goodnight); (ii) millipedes (Nell B. Causey); (iii) collembola (Kenneth Christiansen); (iv) pselaphid beetles (Orlando Park); (v) anophthalmid beetles of the family Carabidae (C. H. Krekeler and T. C. Barr); and (vi) silphid beetles of the genus *Ptomaphagus* (T. C. Barr). The concerted efforts of a number of collectors have within the past decade done much to make adequate series of American cavernicoles available to systematists, and thus to make possible this symposium.

A symposium on karst phenomena, arranged by William E. Davies, was cosponsored with the Geological Society of America.

THOMAS C. BARR, *Program Chairman*

Zoological Sciences (Section F)

The Section F meetings at Indianapolis in 1957 were especially successful in the very wide coverage of subjects of the symposia and contributed papers. Most of the special fields of research interest of the large membership were represented in the program. The attendance was good throughout the program.

There were about 75 present for the first session of contributed papers selected for extended presentation on Friday morning, at which L. S. Dillon (A. & M. College of Texas) outlined a new statement of evolutionary relationships between microorganisms, higher plants, and animals, and R. H. Foulkes (St. Louis University) described the Vatican film library of historically valuable scientific documents being assembled at St. Louis University. At the symposium that evening before an audience of 200, W. R. Breneman (Indiana University) and his colleagues outlined for the nonspecialist the current understanding of pituitary function.

On Saturday morning the regular session for contributed papers was attended by 40 to 75 members. The papers which drew the most interest, as indicated by the discussion, were those on electrophoretic analysis of animal sera as a method for determining relationship, by K. R. Woods (New York Hospital–Cornell Medical Center) and E. Paulsen and colleagues (Rutgers University), and the papers on radioactive isotopes in human cadavers by A. R. Schulert and A. Walton and their associates (Columbia University).

On Saturday afternoon the first session of the joint symposium with Section G on "Some Unsolved Problems in Biology" drew the largest attendance of the Section F meetings—nearly 300 members. This session consisted of six papers on the geographic distribution of contemporary organisms by P. S. Martin (University of Montreal), A. J. Sharp (University of Tennessee), H. H. Ross (Illinois Natural History Survey), W. F. Blair (University of Texas), K. C. Parkes (Carnegie Museum, Pittsburgh, Pa.), and E. L. Cockrum (University of Arizona). There was much discussion after each paper. It is expected that the papers at this session will be published in a single monograph. The second session of this symposium was held on Sunday morning, and it is being covered by the report of the secretary of Section G.

On Sunday afternoon members enjoyed a get-together in the headquarters room of the Society of Systematic Zoology, where many appreciated the opportunity to examine the excellent collection of books of all publishers in all fields of zoology assembled by the secretary of the society, R. E. Blackwelder. This recurring exhibit continues to be one of major interest to all biologists, and it should be encouraged.

On Sunday evening the annual zoologists' dinner was held under the joint sponsorship of Section F and the Society of Systematic Zoology. The challenging address of the vice-president of the AAAS for Section F, E. R. Hall (University of Kansas), was given after this dinner, on the subject "Conservation and the animal biologist." An interesting coincidence was that the subject was somewhat similar to that of the presidential address of the retiring president of the AAAS, Paul B. Sears. The two addresses covered different ground, yet they demonstrated that the theme of conservation is of major importance to biologists at the present time.

The Section F program was concluded with the two sessions on Monday on the subject of the effects and the social consequences of low-level irradiation developed by fallout from nuclear detonations. This program was arranged by A. M. Brues and his colleagues of Argonne National Laboratory. The papers included the newest reviews of the scientific data from all angles, discussions of the responsibilities of the Public Health Service, of the press, of legislators (presented by Chet Holifield, Congressman from California), and an estimate of scientists' ethical responsibilities (given by C. W. Churchman). That this is still a subject of very widespread interest to scientists and the public was shown by the large attendance (100 at each session) and by the wide local press coverage at this and the Sunday afternoon sessions of AAAS on a similar subject, under the chairmanship of C. D. Leake. It is hoped that both of these programs will be published shortly.

HAROLD H. PLOUGH, *Secretary*

Society of Systematic Zoology (F2)

The Society of Systematic Zoology held its 10th annual meeting at Indianapolis. As usual, the activities centered around the book lounge, where there were displayed about 1000 books, representing the zoological output of nearly 90 publishers. This unique assemblage of books gives opportunities for close examination, comparison, and discussion of books that are not otherwise available. It again proved popular, especially among teachers at all levels.

A new feature was a special table of books published during 1957. The number of outstanding books in this category emphasized the extent of current commercial publication, just as the exhibit as a whole demonstrated both the great diversification of biology and the essential unity of its concepts.

A brief session for contributed papers demonstrated the interest of members in discussing the subjects presented and may lead to regular provision for more extended presentation of papers.

The future activities of the society were the subject of much planning, especially in the council meetings. There was determination to continue the society's interest in the broader aspects of biology, relating systematics to other fields. A new constitution was made ready for submission to the members, and many plans were made for an extensive program at the 1958 annual meeting, to be held with the AAAS in Washington, D.C., 27–30 December.

Other sessions were held in collaboration with the other biological societies present, and our member E. R. Hall gave the address at the zoologists' dinner as vice-president of the AAAS for Section F, on the subject "Conservation and the animal biologist."

R. E. BLACKWELDER, *Secretary*

Beta Beta Beta Biological Society (FG2)

Beta Beta Beta Biological Society held its biennial convention in Indianapolis, Ind., 27 Dec. 1957. This society is an affiliated society of the American Association for the Advancement of Science. The most important action taken at the business meeting was the election of a new president to succeed B. R. Weimer of Bethany College. Weimer had completed his two terms as president.

The new president is George H. Mickey, professor of biology at Louisiana State University. Mickey's field of research is cytogenetics. His doctorate is from the University of Oklahoma. He has been a Guggenheim fellow and has a distinctive research to his credit.

Following the luncheon of Beta Beta Beta at the Claypool Hotel, a large group of members listened to the address of Harry J. Fuller of the University of Illinois. His subject was "The psychology of plants."

MRS. FRANK G. BROOKS, *Secretary*

Biometric Society, Eastern North American Region (FG3)

The Biometric Society (Eastern North American Region) presented two sessions on 27 Dec. in Indianapolis as a part of the annual meeting of the American Association for the Advancement of Science. These sessions were cosponsored by the Ecological Society of America and the American Statistical Association. The first session, presided over by Boyd Harshbarger, was devoted to a special invited address, given by Sir Ronald A. Fisher (Cambridge University), entitled "Smoking and lung cancer: an example of the interpretation of statistical data in the observational sciences."

The second session, presided over by T. A. Bancroft, included seven contributed papers: "Cumulatively grouped response times in quantal response data," by Robert F. White (Iowa State College); "Some uses of statistical analysis in classifying races of the American shad (*Alosa sapidissima*)," by Donald R. Hill (Minnesota Mining and Manufacturing Company, St. Paul); "The analysis of groups of similar experiments," by Basilio Rojas (Iowa State College); "Estimation of risk when units are sacrificed periodically during the follow-up interval," by D. Kodlin (Graduate School of Public Health, University of Pittsburgh); "The use of idempotent matrices in regression problems involving linear restrictions," by John S. Chipman and Malempati Rao (University of Minnesota); "Monitoring and evaluating treatment effects in epileptics by a graphical sequential test," by Eugene A. Johnson (University of Minnesota); and "The use of an inverse matrix in the analysis of crossbreeding data," by R. W. Touchberry (University of Illinois).

T. A. BANCROFT, *Program Chairman*
E. P. KING, *Chairman of Local Arrangements*

Ecological Society of America (FG4)

The concurrent sessions of contributed papers in plant ecology and in human, general, and animal ecology were noteworthy for the diversity of topics and for the wide geographic coverage of the research reported. Donald B. Lawrence presided over a botanical session in which areas ranging from the Arctic to Brazil were covered. In the session presided over by Orlando Park, zoological papers based on regions in Africa, Thailand, and the Caroline Islands were presented; this session included an outstanding report by Frank B. Golley on productivity in a Michigan old-field food chain. These sessions were each attended by approximately 80 persons.

Cutting across interdisciplinary boundaries, the session of invited papers on sexual behavior, under the chairmanship of John Emlen and sponsored by the society's section on animal behavior and sociobiology, attracted an audience of about 200.

Several symposia which were cosponsored by the Ecological Society of America were considered highly valuable by the large numbers of our membership in attendance. It will be the hope of all ecologists who heard the pertinent address of the retiring AAAS president, Paul B. Sears, that the address will receive the public attention that the times require for the thoughts presented.

ALTON A. LINDSEY, *Program Chairman*

National Association of Biology Teachers (FG6)

Over two hundred members of the National Association of Biology Teachers were in attendance at the annual meeting. The session on "Outdoor Biology" developed the need for more and better use of outdoor laboratories in the areas of soil studies, aquatic biology, ornithology, and ecology. Program participants included John Brainerd, H. Seymour Fowler, John C. Ayers, Walter H. Brown, Rex Conyers, and Robert Bullington.

Highlight of the luncheon, at which the new officers were installed, was the address on "Germ-free laboratory animals" by James Reyniers, director of the Lobund Institute, University of Notre Dame. The afternoon session was devoted to a symposium on "Teaching Problem Solving in Biology" led by J. Darrell Barnard, with high-school teachers Dorothy Vaughn, Wallace Good, James Otto, and Elizabeth Crider contributing papers.

The association held two 1-hour sessions for the presentation of science-teaching films. These sessions were arranged by Emery Will. The association also cosponsored the joint symposium of all teaching societies on "Teaching the Major Concepts: Relativity, Evolution, and Individuality of Man."

The final day was spent on a joint field trip with the American Nature Study Society to Bradford Woods and to the headquarters of the American Camping Association, where members learned much of the natural history of the area from leaders Max Forsythe, Howard Weaver, and E. L. Palmer.

Other sessions included a membership committee meeting at which nine state chairmen were present, an open committee meeting on "Outdoor Laboratories" attended by 30 members, and editorial and executive board meetings. Plans were made to meet with the American Institute of Biological Sciences, at Bloomington, Ind., in August, and with the AAAS in Washington, D.C., in December.

IRENE HOLLENBECK, *President*

Botanical Sciences (Section G)

The program of Section G at Indianapolis represented a continuation of a tendency in a direction of symposia of wide interest to botanists and other biologists. This year a highly successful symposium on "Polarity, Heads or Tails?" was organized by Dr. A. C. Leopold (Purdue University), who presided. A series of searching papers on this important phenomenon was presented before an audience of more than 100.

On the following day Section G, together with Section F, held the second of what promises to be a series of annual symposia on "Unsolved Problems in Biology," the first of which was held in 1956. In this symposium speakers directed attention to unresolved issues in a series of major problems of interest to biologists. The papers were well received and provoked a good deal of interesting discussion. Attendance amounted to several hundred. There appears to be good reason to continue this type of symposium in the future.

A high point of the meeting was the annual Botanists' Dinner, the success of which was largely due to the efforts of M. T. Hall (Butler University). About 80 botanists and friends attended to hear the retiring chairman of Section G, Harry J. Fuller (University of Illinois), present a delightful account of

some of his incisive thinking on botanical teaching. In addition to the foregoing the section program included 17 contributed papers which were presented at two separate sessions.

BARRY COMMONER, *Secretary*

Psychology (Section I)

The program at Indianapolis, like those of recent years, consisted of a vice-presidential address and six symposia on research of current interest. Neal E. Miller (Yale University) delivered the vice-presidential address on "Experiments on fear and conflict." The symposia of invited papers were on the general topics of human engineering, psychopharmacology, early experience, psycholinguistics, signal detection, and statistical learning theory. The section plans to present about the same kind of program, but on different topics, at the Washington meeting in 1958. The vice-president for 1958 is B. F. Skinner (Harvard University), and the new committeeman-at-large is L. H. Lanier (University of Illinois).

CLIFFORD T. MORGAN, *Secretary*

Social and Economic Sciences (Section K)

The program of the AAAS Section on Social and Economic Sciences at the annual meeting in Indianapolis included, for the first time, participation by all four major social science organizations—the American Economic Association, the American Political Science Association, the American Sociological Society, and the American Statistical Association. Another first for the section was registered by a successful session for contributed papers as a climax to the general program.

The American Economic Association, the National Academy of Economics and Political Science, and Section K, with the National Social Science Honor Society Pi Gamma Mu collaborating, presented a symposium on "Social Aspects of Urban Agglomeration. The final address of this session comprised the vice-presidential address of Stuart A. Rice (Stuart Rice Associates). The other participants in the session were Luther H. Gulick (Institute of Public Administration) and Coleman Woodbury (University of Wisconsin), with Carroll L. Christenson (Indiana University) presiding on behalf of the American Economic Association. The papers of this meeting were of exceptional quality, and the provocativeness of the speakers prompted lively comment in the discussion period.

The American Political Science Association conducted a symposium on

"Studies in Electoral Behavior" in a joint session with the Midwest Conference of Political Scientists and Section K. Papers were presented by James A. Robinson (Congressional fellow of the American Political Science Association) and Warren E. Miller (University of Michigan). Discussants were Jean Driscoll (University of Wisconsin), Frank Munger (Syracuse University), and Philip S. Wilder (Wabash College). Charles S. Hyneman (Indiana University), who arranged the program, presided.

A symposium on "Current Research on Population" was presented by the American Sociological Society, jointly with Section K. An exceptionally distinguished group of authorities on population problems gave papers and contributed to the discussion. These included Philip M. Hauser and Otis D. Duncan (University of Chicago), T. Lynn Smith (University of Florida), Pascal K. Whelpton and Arthur A. Campbell (Miami University), and Ronald Freedman (University of Michigan). The presiding officer of this session, and the arranger of the program, was Vincent H. Whitney (Brown University). The American Sociological Society, along with Section K, also cosponsored the program of the American Psychiatric Association on "Rehabilitation of the Mentally Ill: Social and Economic Aspects, Parts I–IV."

The American Statistical Association and Section K cosponsored an address by P. E. Irick (AASHO Road Test) on "A statistically designed highway experiment." Discussant on this program was C. F. Kossack (Purdue University); H. W. Norton (University of Illinois) presided. A second address featured C. R. Hicks (Purdue University) on "Application of a mathematical model in plastic tooling research." Discussants were E. P. King (Eli Lilly and Company) and I. W. Burr (Purdue University). Presiding was D. L. Cheak (U.S. Naval Ordnance, Indianapolis).

The American Statistical Association also cosponsored a special address with the Biometric Society and the Ecological Society of America, given by Sir Ronald A. Fisher (Cambridge University) on "Smoking and lung cancer: an example of the interpretation of statistical data in the observational sciences." Presiding at this session was Boyd Harshbarger (Virginia Polytechnic Institute). In addition, a joint session for contributed papers of the American Statistical Association and the Biometric Society was held, with T. A. Bancroft (Iowa State College) presiding. The program chairman for the sessions of the American Statistical Association was Virgil L. Anderson (Purdue University).

The session for contributed papers of Section K entertained papers presented by Charles G. Hamilton (College of the

Ozarks) on "Southern public opinion and the Supreme Court," Fred Masserik (University of California) on "Understanding others: theory and research on a cultural *leitmotif*," and Harold Garfinkel (University of California) on "A study of decision-making in complex situations: an analysis of one chess tournament." Donald P. Ray (National Academy of Economics and Political Science), secretary of the section, presided. The success of this session of contributed papers indicates this type of presentation will be useful at future meetings as part of the sectional program. The occasion can provide an approach, at least, to limiting the problem of overspecialization among, as well as within, the fields of social science.

The Metric Association, an affiliated organization in Section K, presented a round-table discussion on "Metric Implementation in Pharmacy, Medicine, and Chemistry," held jointly with AAAS Section Np-Pharmacy. John T. Johnson (University of California) presided. Other sessions in which Section K participated were "Science, Technology, and General Welfare in a Capitalistic Society" with AAAS Section P, together with the vice-presidential address of this section; and the joint symposia series of the Society for the Advancement of Criminology, the Association for the Psychiatric Treatment of Offenders, and the Institute for Research on Crime and Delinquency.

The section officers are deeply appreciative of the efforts of all who participated in the section program and made the Indianapolis sessions a notable success.

Two joint sessions were held by the section during the past year with the regular spring and fall sessions of the National Academy of Economics and Political Science at the Brookings Institution in Washington, D.C. The spring sessions were on "The Middle East and Free World Security," and the fall sessions on "The Economy of the U.S.S.R." The National Social Science Honor Society Pi Gamma Mu collaborated with the National Academy and Section K in these meetings. The proceedings have been published by the National Academy.

Section K was fortunate in 1957 to have had the leadership provided by the distinguished social-statistician, Stuart A. Rice, as chairman. This year the equally distinguished economist, Joseph J. Spengler (Duke University) will serve as chairman, and another eminent economist, Solomon Fabricant (National Bureau of Economic Research), will begin initial service as a member-at-large of the section committee.

DONALD P. RAY, *Secretary*

American Sociological Society (K4)

Population analysis and change, referred to in various other section meetings and in Paul B. Sears' presidential address, received direct attention in three papers presented during a symposium on "Current Research on Population." Philip Hauser and Otis Dudley Duncan (University of Chicago) presented materials on demography as a science from the forthcoming volume *The Study of Population: An Inventory and Appraisal.* They concluded that demography fits the criteria for an observational science and that, despite the early stage of development of its data, methods, and accumulated knowledge, it can offer explanation and prediction of events at least in the short run.

T. Lynn Smith (University of Florida) demonstrated that official data on fertility are generally defective or lacking in Latin America. Presently the best approximations are obtained through the use of fertility ratios. Fertility is clearly very high throughout the area and is likely to remain so for several decades. Fertility in rural areas is generally higher than that in urban areas and, in Brazil at least, fertility rates for whites exceed those for colored.

P. K. Whelpton (Scripps Foundation), with Arthur Campbell and Ronald Freedman, reported on a national probability sample of married white women, aged 18 to 39, in terms of their fecundity, sterility, use of contraceptives, and expected family size. The study was undertaken in part to provide needed understanding of the extent to which the higher postwar fertility in the United States reflects an increase in family size as opposed to a mere change in the timing of marriages and births. The latter appears to be the more important; nevertheless, family size, as measured by completed fertility, may be rising by nearly one child over prewar levels.

VINCENT H. WHITNEY,
Program Chairman

American Statistical Association (K5)

During the morning session of the American Statistical Association there were 25 people present. The room had very adequate facilities—in fact, two chalkboards were made available for this session. The program was very stimulating. P. E Irick presented the material on "A statistically designed highway experiment" in an excellent manner, and the audience participated actively. The paper was 1 hour in length; the formal discussion and the audience discussion took another hour and three quarters. The whole problem of highway experimentation by means of statistical designs and techniques should be of interest to every citizen when one considers the size of the highway projects in the United States. Just this relatively small project is costing over $15 million.

The afternoon session, on "Application of a mathematical model in plastic tooling research," was poorly attended; this was disappointing because the Indiana Chapter of the ASA, as well as the ASQC, had indicated an interest in this subject. I suspect that the scheduling of sessions on a Saturday afternoon is not conducive to attendance, especially if people are not paid by their companies to attend sessions during this time. This conclusion is a bit disturbing but, I believe, realistic. Anyway, the session was modified a bit because only professional people were present and the paper had been written primarily for engineers, who could apply the statistical techniques to their problems.

VIRGIL L. ANDERSON,
Program Chairman

History and Philosophy of Science (Section L)

In 1957 Section L was greatly handicapped by the illness of its secretary, Jane Oppenheimer, who broke her hip.

However, good friends of the section in the AAAS headquarters and in other sections lent suppport, and at the annual meeting Section L held two sessions on Sunday, cosponsored by Section Np (Pharmacy) and the Philosophy of Science Association, and one session on Monday, cosponsored by the Philosophy of Science Association.

The Sunday morning symposium, "Can Science Provide an Ethical Code?", presided over by Hermann J. Muller, was exceptionally well attended. Because Henry Margenau was ill, his paper was read by Lewis K. Zerby. The answer to the symposium question is "yes," as was ably argued by the speakers, who included Chauncey D. Leake and Richard Rudner. The prepared papers were followed by general discussion.

Each of the three very different papers of Sunday afternoon—on Albertus Magnus' scientific method by Father William H. Kane, on pharmaceutical manufacturing by K. K. Chen, and on the thermometric scale by D. J. Lovell—was followed by questions which served to bring further elucidation from the speakers. Norwood Russell Hanson presided.

On Monday morning, a view of man-machine systems, presented by George O. Wright, was followed by a survey by Dorrit Hoffleit of astronomy's development in the 20th century and by a talk by Karel Hujer describing the emphasis on dialectical materialism in the treatment of the physical sciences behind the iron curtain. I. Bernard Cohen's vice-presidential address on "The history of science and the problems of understanding the science of today" concluded the series of papers. C. Doris Hellman presided.

At a business meeting immediately following the papers, regret at Jane Oppenheimer's illness was expressed, and the names of the new section chairman, Carl B. Boyer, and the new committee-member-at-large, Adolf Grünbaum, were announced. It was reported that a national committee for the history and philosophy of science was being formed under the auspices of the National Academy of Sciences–National Research Council and that this committee would become the adhering body for the International Union of History and Philosophy of Science.

C. DORIS HELLMAN, *Acting Secretary*

General Systems Research (L2)

Two of the contributions to the symposium, "Organization for Humans, Cells, and Artifacts," were basically mathematical. A paper by C. Foster, A. Rapoport, and E. Trucco (presented by A. Rapoport) was concerned with the conditions under which Prigogine's theorem of minimum entropy production could be applied to nonisolated systems of known internal structure. It was shown that, if a minimum exists, certain constraints upon the topological arrangement of the feedback loops are implied. M. Kochen presented a procedure for treating an organized system with discrete, synchronized information transfer between its parts, formalizing certain aspects of cooperative group behavior so that it is possible to describe how subunits can be selected and interconnected so as to produce a system with specified behavior.

K. E. Boulding took up the implications of such efforts in his presidential address. He suggested that four levels of systematic knowledge could already be discerned, including (i) purely empirical systems based upon constant interaction; (ii) maps, and blueprints, and plans; (iii) systems used for the design of artifacts; and (iv) theoretical models which explain and predict the "inner workings" of the other systems. General systems research aims at a fifth level—systems of theoretical systems. As these are found, it is expected that marked economies would result in work directed at the first four levels. This should have important consequences in the conduct of the affairs of national states.

As long as the possessors of scarce knowledge were restricted to physical and biological systems, the skills for operating the state could be purely empirical (for example, politics, business, and law) and scientists would perform as specialized experts. But with progress in operations research, administrative science, and other general systems approaches, a conflict may be foreseen between the "folk" culture and the scientific subculture embedded in it.

How do "the people" control the specialists? Democratic theory is based upon the assumption that the kind of knowledge required for government is not scarce or difficult. Are we doomed to another Middle Ages, with Science as the Church and the Military as the King? A growing self-consciousness of science itself as a social system may offer means for resolving such conflicts and preventing such eventualities.

RICHARD L. MEIER, *Secretary-Treasurer*

Medical Sciences (Section N)

This program was the first symposium on the human integument that had been arranged before an AAAS meeting. The title was "The Human Integument—Normal and Abnormal." The program was organized as a symposium with four half-day sessions, jointly with the AMA

Committee on Cosmetics and the Society for Investigative Dermatology.

The first session was on "The integument as an organ of protection." In this session considerable attention was given to the cells forming the barrier to absorption of various molecular structures. A very interesting and informative paper by Robert D. Griesemer (Harvard Medical School (outlined in terms of the physical chemistry of membranes some of the problems related to the transfer of molecules across the skin barrier. It was clearly evident from the discussion how anatomical considerations make precise studies of this nature very difficult.

In the second session of the symposium, "Circulation and vascular reactions," Benjamin W. Zweifach (New York College of Medicine) outlined some very fascinating experimental studies on the hemodynamics of skin circulation and the pharmacological effects produced by toxins and drugs such as epinephrine, which is a well-known vasoconstricting substance, and a very interesting synergistic action between epinephrine and bacterial toxins in tissues which had been depleted of histamine and serotonin was described. Alan C. Burton (University of Western Ontario) reviewed the physiological considerations of cutaneous circulation.

In the third session of the symposium, "Sebaceous gland secretion," Eugene J. Van Scott (National Institutes of Health) described with beautifully illustrative slides the anatomical structures of the skin and subcutaneous tissues, with particular reference to sebaceous glands. Differences between skin taken from different parts of the body in relationship to the etiology of acne vulgaris were discussed. Allan L. Lorincz (University of Chicago), in a paper describing the biochemical-hormonal aspects of sebaceous secretion, outlined investigations which gave relatively strong evidence that a sebatrophic factor exists in secretions of the anterior pituitary.

In the last session, on the "Pathogenetic factors in premalignant conditions and malignancies of the skin," Raymond R. Suskind (Kettering Institute, Cincinnati, Ohio), discussed accelerator substances in the production of skin cancer, showing how certain chemical substances frequently used as solvents, when employed in proper sequence, considerably potentiate the carcinogenic action of well-known coal-tar hydrocarbons.

ALLAN D. BASS, *Secretary*

Dentistry (Section Nd)

Two half-day sessions and one evening session were held by Section Nd; the average attendance was 60. Each of the sessions was devoted to discussions of

recent studies of possible deleterious effects on general health of fluorides as used for the prevention of dental caries. Thirteen papers were presented.

Specific studies were reported on the relation of fluorine intake to enzymes, lipoid metabolism, periodontal tissues, and the human skeleton. No significant effects in any of these areas were observed for daily intakes below five parts per million. No toxic effects resulting from communal water fluoridation have been found. Public health surveys covering 32 pairs of cities and thousands of people showed no relation of fluoridation to mortality or to the occurrence of heart disease, cancer, nephritis, and other diseases. Studies related to the sources of fluorine and its excretion from the body were also reported.

The legal counsel of the American Dental Association stated that, in every state in which the legality of water fluoridation has been challenged, it has been established by every state supreme court. The United States Supreme Court has refused to review the actions of the lower courts in the four instances in which the ruling has been appealed.

In none of these presentations was there reported any evidence that questioned the safety or advisability of adding fluoride to communal water supplies.

The consensus of the symposium was expressed by Harold Hodge when he said, "The safety of water fluoridation is sufficiently assured. We recommend that communities proceed to adopt it."

Section Nd also cosponsored and participated in a program on "Premedical and Predental Education" given by Alpha Epsilon Delta.

R. W. BUNTING, *Secretary*

Pharmacy (Section Np)

Section Np held nine sessions, 27–30 Dec., at Indianapolis. A total of 26 contributed papers on original studies were reported, and one round-table discussion and two symposia were held. Over 200 persons registered as having attended one or more of the section meetings.

The AAAS Council, the governing body of the association, elected George F. Archambault, chief of the Pharmacy Branch of the U.S. Public Health Service, as vice-president of the Association and elected J. V. Swintosky, of the Smith, Kline and French Laboratories, to serve on the committee-at-large of the section for a 4-year term. Archambault will also serve as chairman of the section for the coming year.

Of considerable interest was the symposium on "A Pharmacological Approach to Mental Illness," which attracted interest outside the pharmaceutical group in attendance. Various aspects of the pharmacology of mental ill-

ness were discussed by five experts in the field. J. I. Nurnberger (Indiana University) served as moderator. I. H. Slater (Lilly Research Laboratories) discussed the general pharmacological aspects. T. Verhave (Lilly Research Laboratories) discussed animal behavioral studies of drugs used in mental illness. N. S. Kline (Rockland State Hospital, Orangeburg, N.Y.) discussed clinical studies of the important drugs used in mental illness. J. Cole (National Institutes of Health) discussed the function and operation of the recently formed Psychopharmacology Service Center at NIH.

R. C. Anderson (Eli Lilly and Company), chairman of the section, opened the contributed papers sessions. The papers presented were of unusual merit. G. I. Jenkins and coworkers (Purdue University) reported on the synthesis of a series of diphenic acid derivatives. The synthesis of epoxide polymers of steroidal compounds was discussed by W. F. Head (Eli Lilly and Company) and W. M. Lauter (University of Florida). H. Schriftman (Wyeth Institute) presented a method of analysis of phenylephrine by use of filter paper chromatography. D. E. Cadwallader (University of Florida) discussed the effect of salts on the permeability of red corpuscles. G. S. Banker and J. E. Christian (Purdue University) presented radioactive tracer techniques for studying the uniformity of distribution of ingredients in tablet matrices. Methods for the measurement of the particle size of powders were reported by J. V. Swintosky. Gastric and intestinal absorption of penicillin was discussed by R. O. Froman, R. C. Anderson, and C. C. Lee (Lilly Research Laboratories). O. B. Myres (Butler University) presented information on the gastrointestinal absorption of isoniazid, PAB, and promizole. C. N. Rice (Eli Lilly and Company) discussed the lymphatic absorption of β-sitosterol and cholesterol. The tissue distribution of salicylamide and the oxidation metabolites of salicylates were reported by W. F. Bousquet and J. E. Christian (Purdue University) and R. E. Crabtree (Eli Lilly and Company).

The Hospital Pharmacy group had a very informative and well-attended full-day session under the direction of G. F. Archambault (U.S. Public Health Service) and J. A. Oddis (American Hospital Association). Representatives of a number of organizations were present and participated in the meeting, discussing several important subjects of direct interest to the hospital pharmacist, including legal and other implications in the labeling of nursing station medication containers, local poison control centers, legislative controls over hospital pharmacy at the state level, hospital pharmacy committees, economics and the profession, and several other questions. A symposium on "Recent Trends in Medication" included the following participants: C. J. York (Pitman-Moore Co.) spoke on tissue culture; R. H. Behnke (Veterans Consolidated Hospitals) spoke on drug therapy in cardiovascular disease; H. D. Bryan (Mead Johnson & Co.) presented recent trends in pediatric medication; and R. C. Bogash (American Society of Hospital Pharmacists) discussed compatibilities of intravenous and intramuscular admixtures. Luncheon, entertainment, and dinner were sponsored by Eli Lilly and Company, Mead Johnson & Company, and McKesson and Robbins, Inc., respectively.

On Sunday, 29 Dec., the Pharmacy Section held joint sessions with the Section on the History and Philosophy of Science and with the Philosophy of Science Association, during which a symposium, "Can Science Provide an Ethical Code," was held.

Ralph W. Ernsberger (Eli Lilly and Company) presented a paper on how metric advantages can be and have been implemented in pharmaceutical manufacturing. This was followed by a round-table discussion moderated by J. T. Johnson, president of the Metric Association. R. J. Dille, R. W. Ernsberger, J. F. Hollings, J. E. Schneider, and R. G. Weigel participated in the discussion.

Eli Lilly and Company sponsored a luncheon and tour of the pharmacological research facilities on Monday.

JOHN E. CHRISTIAN, *Secretary*

Agriculture (Section O)

"Biological and Chemical Control of Plant and Animal Pests" was the theme of the 1957 meetings of Section O. The section chairman, Louis P. Reitz (U.S. Agricultural Research Service), arranged a four-part symposium which provided for a rather full discussion of the topic by outstanding workers from the United States, Canada, and Sweden.

The first session covered recent advances in chemical control measures. Included were papers on insecticides, herbicides, fungicides, and bactericides, as well as on systemic antibiotic chemicals. "Recent advances in biological control measures" were discussed in the second session. There were papers on parasites, predators, pathogens, and irradiation for pest control. Forest insects and diseases were discussed at this session.

Another part of the symposium was devoted to "Inherent resistance to pests," including animal diseases, plant insects, and diseases of field and horticultural crops. One paper covered the relation of host nutrition to pest reaction. The final session included such subjects as biological balance, exclusion and eradication, education in the use of pesticides, and effects of regulatory control on evaluation of safety and suitability of chemicals. Twenty-one well-prepared papers were presented at the four sessions. Those who attended the meetings were able to get a good understanding of recent developments in the very important field of pest control. As the papers were presented it became evident that, to be successful, all available methods of control must be used. It was also pointed out that, in spite of rapid advances, much more basic research is needed if the pests of the future are to be controlled.

The new AAAS–Campbell Award for Vegetable Research was presented to S. H. Wittwer and F. G. Teubner (Michigan State University), for their basic and applied research on flower formation and fruiting in tomato. The award consisted of $1500, and a bronze medal was presented by Reitz.

Interest in the topics under discussion was maintained throughout the four sessions, and it is unfortunate that more people were not in attendance.

K. S. QUISENBERRY, *Secretary*

Industrial Science (Section P)

At a dinner on Thursday, 26 Dec., the Section's Annual Industrial Science Achievement Award was presented to P. R. Mallory and Co., Inc., Indianapolis, Ind., in recognition of the development of a new powder metallurgy process, Steelmet, which promises to have widespread industrial application. F. R. Hensel, vice president in charge of engineering, accepted the award on behalf of the company. Harold Sigurdson, director of research and engineering for the Metallurgical Divisions, presented a technical paper describing the new process.

The Friday symposium, arranged by Allen T. Bonnell (Drexel Institute of Technology), section secretary, and chaired by Frank C. Croxton (Battelle Memorial Institute), section chairman, was entitled "Science, Technology, and General Welfare in a Capitalistic Society."

Louis C. McCabe (Resources Research, Inc.) stated that, because of the current shortage of scientific and technological manpower, "general welfare does not fare well." Public agencies are not adequately staffed to set standards for industry, and the drive for competitive advantage often leads companies to introduce products and processes which are harmful, immediately or cumulatively. Urbanization and industrialization have given new dimensions to old pollution problems, and a new pattern of controls is in order.

Robert Doolittle (Youngstown Sheet

and Tube Company), in a review of one industry's program for reducing stream pollution, pointed to the need for accurate fact-finding as a preliminary to further public regulation. Much of the data needed to guide public regulation can be developed by the interested industries. This is one of the challenges to industries, one which they must attempt to meet if they are to be certain that the regulations ultimately adopted accomplish, most economically, the desired objectives.

G. E. Kimball (Arthur D. Little, Inc.) was of the opinion that it was impossible to "maximize profits and to maximize public welfare" simultaneously. Modern management is beset by many problems of which the safeguarding of public welfare is only one. Since the goal of management is now the maximum long-run profit, corporations now have incentive to adopt self-constraint in matters affecting public welfare, especially since a failure to do so may invite external restraints. Eventually, the public must pay the cost of programs designed to enhance public welfare, either in the form of taxes or higher prices.

The Industrial Science Section vice-presidential address was given by Monroe E. Spaght (Shell Oil Co.) at the annual luncheon meeting following the symposium. In discussing "The companies we keep," Spaght traced the historical evolution of the modern corporation and stressed the fact that the unlimited life of the "corporate" citizen tended to impose new responsibilities of "corporate citizenship."

ALLEN T. BONNELL, *Secretary*

Society for Industrial Microbiology, Washington Section (P2)

The Washington Section of the Society for Industrial Microbiology sponsored a symposium on 28 Dec. on "Some Areas in Industrial Microbiology" in conjunction with Section P. A group of papers showed the panorama from fermentation, an old industry in which all operations are essentially industrial microbiology, to mining, another old industry but one in which microbial research is just beginning to be used. W. D. Stewart (Atlantic Research Corporation) presided.

J. E. McClary (Anheuser-Busch, Inc.), in reviewing "Microbiology in the fermentation industries," pointed out that fermentation is the oldest microbial industry and that its microbial problems are similarly the oldest. Present problems include obtaining clean, bright grain, storing it to avoid deterioration, and processing it without damage to quality by microbial contamination.

"Microbiologists in the prevention of

deterioration" was discussed by Carl J. Wessel (Prevention of Deterioration Center). Damage to materials, particularly in vessels, has been recognized since Biblical times, but this line of work has become a separate discipline, primarily because of the losses of military equipment which have occurred during the past 20 years. Approaches to the problem of preventing damage can be made by fungitoxic treatments, choice of naturally resistant materials, and special design to avoid conditions that favor deterioration.

J. M. McGuire (Lilly Research Laboratories) talked on "Industrial microbiology in the pharmaceutical industry." He noted the trend from immunologic work to chemotherapy (with the introduction of sulfonamides and antibiotics) and now toward microbial manufacture of acids, vitamins, and steroid hormones. Views were shown of detailed procedures, from the isolation of soil organisms to the detection, identification, manufacture up to the pilot-plant stage, and testing of antibiotics from the isolates.

"Microbial research in the bureau of mines" was summarized by Walter N. Ezekiel (U.S. Bureau of Mines). Exploratory studies are under way on the microbiology of coal, on the use of bacteria to recover hydrocarbons from oil shale, and on microbial metallurgy which might provide new approaches for obtaining metals from low-grade ores.

WALTER N. EZEKIEL, *Program Chairman*

Education (Section Q)

As in preceding years, Section Q cooperated with other agencies in cosponsoring programs of mutual interest. Section Q joined with the International Council for Exceptional Children to present two programs. A session of contributed papers and a panel presentation on "Problems of gifted children," were held. The latter program was especially timely in view of the recent emphasis on better education for the talented. The American Educational Research Association and Section Q also cosponsored programs of contributed papers. The first session was devoted to problems pertaining to higher and adult education, the second to problems of learning and motivation.

The AAAS Cooperative Committee joined with Section A (Mathematics) and the National Council of Teachers of Mathematics to present a symposium on mathematics instruction. The teaching societies NSTA, NABT, NARST, and ANSS presented an outstanding series of meetings and tours, which were well attended.

Two major addresses were delivered

in Section Q. J. Hartt Walsh presented a paper on "The Federal Constitution and judicial philosophy." The vice-presidential address by Arthur E. Traxler was devoted to "An appraisal of American colleges on the basis of men graduates listed in *Who's Who in America*." A business meeting was held after the two addresses. Considerable time was devoted to the discussion of Section Q's function and to the nature of some of the programs which it might be profitable to develop for future meetings.

HERBERT A. SMITH, *Secretary*

Conference on Scientific Manpower (X5)

The theme of this year's Conference on Scientific Manpower was "Scientists and Scientific Research in a Changing Economy." Both morning and afternoon sessions were held on 30 Dec.

Robert C. Turner (Indiana University) presided at the opening session, which included three papers. Yale Brozen (University of Chicago), in discussing the relation of scientific advance to economic change, noted the rich returns to private investors from applied research and suggested that Government funds be concentrated on fundamental research. Julian W. Feiss (Kennecott Copper Co.) emphasized that the new functions being undertaken by scientists had important implications for education to improve training; for government to support education without restricting academic freedom; for industry to assure proper utilization and adequate compensation; and for the scientists themselves to assume positions of public responsibility and leadership. William D. Carey (U.S. Bureau of the Budget) presented a thoughtful paper on "The support of scientific research." After showing the increasing Government support of scientific research, he proposed experimentation with long-range research goals as opposed to a year-by-year determination of program. The intimate relationship between science and national security he believed to be a cause for concern.

The afternoon session, concerned with papers on training and salary levels of scientists, was presided over by Ralph E. Cleland (Indiana University). Herbert E. Longenecker (University of Illinois) spoke of "New dimensions in training scientists" from the standpoint of students, the body of knowledge to be taught, faculty, facilities, and what might be termed some of the "hard realities" in which the educational process operates. Ralph E. Bennett (General Electric Co.) discussed the variety of methods by which industry currently supports training in science and technology; he was hopeful that the challenge to our position of scientific leadership is now being recognized in the home. Thomas J. Mills (National Science Foundation) presented some comparisons between scientific salaries and other economic measures and questioned whether the salary rewards of scientists and engineers might not be a limiting factor on the desired expansion of these professions.

The papers delivered at the conference will be published by the National Science Foundation. A limited number of copies will be available for distribution by that agency.

THOMAS J. MILLS, *Program Chairman*

Forthcoming Events

March

20–22. Michigan Acad. of Science, Arts and Letters, annual, Ann Arbor. (R. F. Haugh, Dept. of English, Univ. of Michigan, Ann Arbor.)

20–22. Pulmonary Circulation Conf., Chicago, Ill. (Wright Adams, Chicago Heart Assoc., 69 W. Washington St., Chicago 2.)

20–23. International Assoc. for Dental Research, annual, Detroit, Mich. (D. Y. Burrill, Northwestern Univ. Dental School, 311 E. Chicago Ave., Chicago, Ill.)

23–26. American Assoc. of Dental Schools, annual, Detroit, Mich. (M. W. McCrea, Univ. of Minnesota School of Dentistry, Minneapolis 14.)

23–29. American Soc. of Photogrammetry, 24th annual, jointly with American Cong. on Surveying and Mapping, 18th annual, Washington, D.C. (C. E. Palmer, ASP, 1515 Massachusetts Ave., NW, Washington 5.)

24–26. Aero Medical Assoc., 29th annual, Washington, D.C. (T. H. Sutherland, Box 26, Marion, Ohio.)

24–27. Institute of Radio Engineers, natl. conv., New York. (G. W. Bailey, IRE, 1 E. 79 St., New York 21.)

26–28. American Power Conf., 20th annual, Chicago, Ill. (Illinois Inst. of Technology, 35 W. 33 St., Chicago 16.)

27–29. American Physical Soc., Chicago, Ill. (E. R. Fitzgerald, Dept. of Physics, Pennsylvania State Univ., University Park.)

27–29. Mechanisms of Hypersensitivity, 8th internatl. symp., Detroit, Mich. (W. J. Nungester, Dept. of Bacteriology, Univ. of Michigan, Ann Arbor.)

27–29. National Science Teachers Assoc., 6th natl., Denver, Colo. (R. H. Carleton, NSTA, 1201 16 St., NW, Washington 6.)

27–29. Optical Soc. of America, annual, Washington, D.C. (S. S. Ballard, Scripps Institution of Oceanography, San Diego 52, Calif.)

28. New Jersey Acad. of Science, 3rd annual, Newark. (H. L. Silverman, Nutley Public Schools, Nutley, N.J.)

29. South Carolina Acad. of Science, annual, Charleston. (Miss M. Hess, Dept. of Biology, Winthrop College, Clemson, S.C.)

29–30. American Psychosomatic Soc., 15th annual, Cincinnati, Ohio. (T. Lidz, 551 Madison Ave., New York 22.)

30–3. American College Personnel Assoc., annual, St. Louis, Mo. (L. Riggs, DePauw Univ., Greencastle, Ind.)

April

1. Microcirculatory Conf., 5th, Buffalo, N.Y. (S. R. M. Reynolds, Dept. of Anatomy, Univ. of Illinois College of Medicine, 1853 W. Polk St., Chicago 12.)

1–3. Corrosion Control, 5th annual conf., Norman, Okla. (M. L. Powers, Extension Div., Univ. of Oklahoma, Norman.)

2–4. American Assoc. of Anatomists, annual, Buffalo, N.Y. (L. B. Flexner, Dept. of Anatomy, School of Medicine, Univ. of Pennsylvania, Philadelphia 4.)

2–4. Instruments and Regulators Conf., Newark, Del. (W. E. Vannah, Control Engineering, 330 W. 42 St., New York 36.)

3–5. Pennsylvania Acad. of Science, annual, Easton, Pa. (G. R. Stevens, Dept. of Geology and Geography, Lafayette College, Easton.)

4–5. Southern Soc. for Philosophy and Psychology, annual, Nashville, Tenn. (W. B. Webb, U.S. Naval School of Aviation Medicine, Pensacola, Fla.)

7–11. American Assoc. of Cereal Chemists, annual, Cincinnati, Ohio. (J. W. Pence, Western Utilization Research Laboratories, Albany, Calif.)

8–10. Electronic Waveguides Symp., New York. (J. Fox, Microwave Research Inst., Polytechnic Inst. of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y.)

9–12. National Council of Teachers of Mathematics, Cleveland, Ohio. (M. H. Ahrendt, NCTM, 1201 16 St., NW, Washington 6.)

9–14. Applied Psychology, 13th internatl. cong., Rome, Italy. (L. Meschieri, National Inst. of Psychology, Rome.)

10–11. American Inst. of Chemists, annual, Los Angeles, Calif. (L. Van Doren, AIC, 60 E. 42 St., New York 17.)

10–12. Biometric Soc., ENAR, Gatlinburg, Tenn. (T. W. Horner, General Mills, Inc., 400 Second Ave. South, Minneapolis 1, Minn.)

10–12. National Speleological Soc., annual, Gatlinburg, Tenn. (G. W. Moore, Geology Dept., Yale Univ., New Haven, Conn.)

10–12. Ohio Acad. of Science, annual, Akron, Ohio. (G. W. Burns, Dept. of Botany, Ohio Wesleyan Univ., Delaware.)

11. Vitamin B-12 Symp., New York, N.Y. (Miss J. Watson, 451 Clarkson Ave., Brooklyn 3, N.Y.)

11–12. Eastern Psychological Assoc., annual, Philadelphia, Pa. (G. Lane, Dept. of Psychology, University of Delaware, Newark.)

11–18. Horticultural Cong., 15th inter-

natl., Nice, France. (Secretariat General, 84, rue de Grenelle, Paris 7e, France.)

12. Society for the Scientific Study of Religion, New York. (L. Whitman, 297 Fourth Ave., New York, N.Y.)

13–14. American Soc. for Artificial Internal Organs, Philadelphia, Pa. (G. Schreiner, Georgetown Univ. Hospital, Washington 7.)

13–18. American Chemical Soc., 133rd, San Francisco, Calif. (R. M. Warren, ACS, 1155 16 St., NW, Washington 6.)

13–19. Federation of American Societies for Experimental Biology, annual, Philadelphia, Pa. (M. O. Lee, FASEB, 9650 Wisconsin Ave., Bethesda 14, Md.)

14–16. Automatic Techniques Conf. Detroit, Mich. (J. E. Eiselein, RCA, Bldg. 10–7, Camden 2, N.J.)

14–18. American Assoc. of Immunologists, annual, Philadelphia, Pa. (F. S Cheever, Graduate School of Public Health, Univ. of Pittsburgh, Pittsburgh 13, Pa.)

14–18. American Soc. for Experimental Biology, annual, Philadelphia, Pa. (J. F. A. McManus, Univ. of Alabama Medical Center, Birmingham.)

14–18. American Soc. of Biological Chemists, annual, Philadelphia, Pa. (P. Handler, Dept. of Biochemistry, Duke University School of Medicine, Durham, N.C.)

15–17. Gas Measurement, 34th annual conf., Norman, Okla. (M. L. Powers, Extension Div., Univ. of Oklahoma, Norman.)

16–25. Instruments, Electronics and Automation Conf., London, England. (Industrial Exhibitions Ltd., 9 Argyll St., London, W.1.)

17–19. Association of Southeastern Biologists, annual, Tallahassee, Fla. (J. C. Dickinson, Jr., Dept. of Biology, Univ. of Florida, Gainesville.

17–19. Eastern Colleges Science Conf., 12th annual, Wilkes-Barre, Pa. (Mrs. E. Stevens, Wilkes College, Wilkes-Barre.)

18. Iowa Acad. of Science, annual, Des Moines. (C. H. Lindahl, Dept. of Mathematics, Iowa State College, Ames.)

18–19. Arkansas Acad. of Science, annual, Little Rock. (L. F. Bailey, Botany Dept., Univ. of Arkansas, Fayetteville.)

19–20. Eastern Sociological Soc., 28th annual, Philadelphia, Pa. (A. Van der Slice, School of Social Sciences and Public Affairs, American Univ., 1901 F St., NW, Washington 6.)

19–21. American College of Apothecaries, Los Angeles, Calif. (R. E. Abrams, Hamilton Court, 39th and Chestnut St., Philadelphia, Pa.)

19–25. Industrial Health Conf., Atlantic City, N.J. (IHC, Room 1313, 28 E. Jackson Blvd., Chicago 4, Ill.)

20–22. American Assoc. of Colleges of Pharmacy, annual, Los Angeles, Calif. (G. L. Webster, College of Pharmacy, Univ. of Illinois, 808 S. Wood St., Chicago, 12.)

20–22. American Soc. of Hospital Pharmacists, Los Angeles, Calif. (Mrs. G. N. Francke, 1812 Norway Rd., Ann Arbor, Mich.)

20–23. Chemical Engineering Conf., Canada-United States, Montreal, Quebec, (H. R. L. Streight, DuPont Company of Canada, P.O. Box 660, Montreal.)

20–23. Numerical Approximation Symp., Madison, Wis. (R. E. Langer, Mathematics Research Center, U.S. Army, Univ. of Wisconsin, 1118 W. Johnson St., Madison 6.)

20–25. American Pharmaceutical Assoc., annual, Los Angeles, Calif. (R. P. Fischelis, APA, 2215 Constitution Ave., NW, Washington 7.)

21–22. National Assoc. of Boards of Pharmacy, Los Angeles, Calif. (R. P. Fischelis, 2215 Constitution Ave., NW, Washington 7.)

21–23. American Oil Chemists' Soc., Memphis, Tenn. (Mrs. L. R. Hawkins, AOCS, 35 E. Wacker Dr., Chicago 1, Ill.)

21–28. American Industrial Hygiene Assoc., annual, Atlantic City, N.J. (G. D. Clayton, George D. Clayton and Associates, 14125 Prevost, Detroit 27, Mich.)

22–24. Electronic Components Symp., Los Angeles, Calif. (E. E. Brewer, Convair, Inc., Pomona, Calif.)

23–26. Internal Medicine, 5th internatl. cong., Philadelphia, Pa. (E. R. Loveland, 4200 Pine St., Philadelphia 4.)

24–25. Eastern States Health Education Conf., New York (I. Galdston, New York Acad. of Medicine, 2 E. 103 St., New York 29.)

24–25. Nutrition Conf., 4th annual, Detroit, Mich. (J. M. Orten, Dept. of Physiological Chemistry, Wayne State Univ., College of Medicine, 1401 Rivard St., Detroit 7.)

24–26. International Scientific Radio Union, spring, Washington, D.C. (J. P. Hagen, National Acad. of Sciences, 2101 Constitution Ave., NW, Washington 25.)

24–26. West Virginia Acad. of Science, annual, Morgantown. (M. Ward. Glenville State College, Glenville, W. Va.)

25–26. American Assoc. of University Professors, annual, Denver, Colo. (R. K. Carr, 1785 Massachusetts Avenue, NW, Washington 6.)

25–26. Georgia Acad. of Science, annual, Emory Univ., Emory. (M. T. Clark, Chemistry Dept., Emory Univ., Emory, Ga.)

25–26. Louisiana Acad. of Sciences, annual, Shreveport. (H. B. Boudreaux, Louisiana State Univ., Baton Rouge 3.)

25–26. South Dakota Acad. of Science, annual, Rapid City. (J. M. Winter, Botany Dept., Univ. of South Dakota, Vermillion.)

27–1. American Ceramic Soc., 60th annual. Pittsburgh, Pa. (C. S. Pearce, ACS, 4055 N. High St., Columbus 14, Ohio.)

27–1. Electrochemical Soc., spring. New York. (H. B. Linford, ES, 1860 Broadway, New York 23.)

27–1. Society of American Bacteriologists, 59th annual, Chicago, Ill. (E. M. Foster, Univ. of Wisconsin, Madison 6.)

27–1. Southwestern and Rocky Mountain Div., AAAS, annual, Las Vegas, N.M. (M. G. Anderson, New Mexico A.&M. College, Las Cruces.)

28–29. Automatic Control in the Petroleum and Chemical Industries, 3rd annual conf., Norman, Okla. (M. L. Powers, Extension Div., Univ. of Oklahoma, Norman.)

28–3. Engineering Societies of Western Europe and the United States, conf. (closed), New York. (C. E. Davies, American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18.)

EQUIPMENT NEWS

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science *does not assume responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to* Science, *Room 740, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ ION-EXCHANGE RESINS of specific utility in chromatographic separation and identification, especially of components of complex amino acid mixtures, are offered in partcile size range of 400 to 600 mesh. Amberlite CG-120 is a strongly acidic cation-exchange resin in sodium form; Amberlite CG-50 is a weakly acidic cation-exchange resin in hydrogen form. (Fisher Scientific Co., Dept. S901)

■ NUCLEAR REACTOR, for training purposes, is prefabricated and can be installed in existing buildings without excavation. The reactor is of the pool type with output of 1 watt. Exterior measurements, installed, are 10 ft high by 14 ft 7 in. by 16 ft 5 in. Water and electricity are the only utilities needed for operation. Price of the complete reactor, including shielding and instrumentation, is expected to be between $135,000 and $150,000. (ACF Industries Inc., Erco Division, Dept. S905)

■ PARTICLE SIZE DISTRIBUTION, in the range 1 to 100 μ, is recorded continuously by an instrument which records the weight of accumulated particles as they settle on a balance pan within the suspension liquid. The integral curve obtained in this way may be converted into a curve relating particle size to number of particles. Sensitivity of the balance is 30 μa/mg. Accuracy is stated to be ± 2 percent. (G. F. Bush Associates, Dept. S906)

■ FLUORIMETER extends the Galvanek-Morrison fluorimeter to detection of beryllium and uranium in solutions. Interchangeable attachments permit quick switching from solid to liquid samples. For analysis of liquids, four 3-ml cuvettes, three sample and one standard, are accommodated on a single slide. Detents locate each sample. (Jarrell-Ash Co., Dept. S908)

■ SOURCE CALIBRATOR is designed for quick determination of the radioactivity of liquid or solid radioisotope sources. Two well-type ionization chambers cover the range from 5 μc to 500 mc. Response is said to be largely independent of sample size and sample position over a wide range. Over-all accuracy is ± 5 percent. (Tracerlab, Dept. S928)

■ INFRARED CAMERA is designed to give a quantitative photographic record of the temperature distribution of the objects pictured. In operation, the camera is sighted on the object to be photographed. An internal mirror scans the object, point-by-point, reflecting radiation from the object onto an infrared detector. A light beam, modulated according to the detected signal, is similarly scanned over a photographic film which is developed to provide a visible image. Temperature differences of 0.02°C can be detected. (Barnes Engineering Co., Dept. S913)

■ VACUUM GAGE combines thermocouple gage for forepump vacuum with a Philips gage for high vacuum. Five ranges extend from 10^{-4} to 10^{-8} mm-Hg. A high-voltage RF power supply excites the ionization gage, and ionization current is measured by a vacuum-tube voltmeter with appropriate resistors. Provision is made for outgassing the heater in the Philips gage. Built-in circuits provide calibration. (Wave/Particle Corp., Dept. S910)

■ REMOTE-HANDLING TONGS are specifically designed for working with high-level radiation within shielded caves, hot cells, and irradiation chambers. The tongs are of ball-swivel construction. The ball swivel itself is completely shielded with lead, and it is mounted directly in the protective wall. A variety of interchangeable heads permits many specialized operations. These heads may be attached remotely and stored within the cell when not in use. (The Atomic Center Inc., Dept. S911)

■ METABOLIC CHAMBER is an air-tight room 13 by 9 by 8 ft with an additional outer space to house heaters, cooling coils, and circulation fans. Air circulation is 1300 ft^3/min, allowing complete exchange within 1 minute with air velocity less than 50 ft/min. Noise level is less than 40 db. Temperatures between 40° and 120°F and relative humidities of 10 to 95 percent are obtainable. Sealed passages allow wires and tubes to be brought into the chamber. (Tenney Engineering Inc., Dept. S914)

■ CERAMIC CEMENT can be used to seal most glasses, ceramics to glass, metal to glass and metal to metal. Service temperature extends to 400° to 450°C. Seals are made at 400° to 450°C, and a short heat treatment transforms the soft cement into a strong glass-ceramic. Materials to be sealed with the cement must have an expansion between 85 and 110×10^{-7} in./in. °C and must be able to withstand the sealing temperature. (Corning Glass Works, Dept. S926)

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Administrative and Research Assistant, Biologist, A.B. Experience includes research and publications in radiobiology, establishment of laboratory and office procedures, purchasing, and personnel. Desires academic or industrial position in medical writing, varied research or administrative work where scientific background is pertinent. Box 44, SCIENCE. X

Bacteriologist, 31, family. Experience: government research, academic (assistant professor). Publications: hydrocarbon, carbohydrate, nitrogen metabolism, analytical chemistry. Ph.D. August 1958. Wants challenging academic position. R. Klausmeier, Department of Bacteriology, Louisiana State University, Baton Rouge, La. X

Microbiologist, Ph.D., 34; 9 years of academic, industrial research: fermentations, quantitative virology, tissue culture, bioassay, extraction and purification of antibiotics. Patents; publications. Presently project leader with prominent midwestern pharmaceutical company. Wishes to relocate East in responsible, challenging research position. Box 42, SCIENCE. 2/28

Pharmacologist, Ph.D. Instructor in medical college desires new teaching position that will enable him to obtain medical degree. Box 37, SCIENCE. X

(a) Physician; 6 years' experience in research nutrition and biochemistry; 7 years as director of research, pharmaceutical company. **(b) Biochemist;** M.S. biochemistry; 10 years, chemist, large industrial company; 4 years, director of biochemistry, government research unit. Medical Bureau, Burneice Larson, Director, 900 N. Michigan Ave., Chicago. X

Research Biologist, Ph.D. Genetics, physiology, nutrition, toxicology; 7 years of university teaching; 6 years as project leader, outstanding research foundation. Desires challenging academic or industrial position. Box 28, SCIENCE. X

Research Scientists, man and wife, Ph.D.; nutrition and biochemistry, foods and chemistry, respectively. Desire relocation other than South or Southwest, commercial or college; 6 years of research experience, publications, ages 36 and 38. Box 38, SCIENCE. 2/28

Zoologist, Ph.D.; 1 year grant supported postdoctoral research. Publications; 6 years' teaching and research at midwestern universities. Vertebrate zoology, ornithology, mammalogy, and ecology. Dynamic, lucid, and meticulous lecturer. Desires university position in teaching and research. Box 41, SCIENCE. 2/28; 3/7

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Applications are invited for a position in the Department of Entomology as assistant or associate professor, starting salary between $6000 and $8000 according to qualifications and experience. Duties, to commence on 1 September 1958, will include teaching and research in the fundamental aspects of applied entomology. There will be some emphasis on agricultural applications. Qualifications in chemistry, physical chemistry, and physics and the ability to conduct basic research in insect toxicology are required in addition to good general training in biology and entomology. Confirmation in the appointment will be subject to the satisfactory completion of a probationary period of from 2 to 4 years. Applications should be addressed to the **Head, Department of Entomology, University of Alberta, Edmonton, Alberta,** and should give personal data, details of training and experience, and the names of three referees. A list of scientific papers published and a recent photograph are also required. Closing date: 15 **April 1958.** X

Bacteriologist, male or female; senior technician with bacteriology-serology training to assist with research at Lobund Institute, University of Notre Dame. State Qualifications. 2/28

Biochemist, male, Ph.D. or M.A. Experience preferred, to head group engaged in industrial research on preparation, isolation, and characterization of enzymes involved in biosynthesis. Present opening result of expansion in this field. Location, New York City. Box 30, SCIENCE. 2/14, 21

(a) Clinical Research Physician; young M.D. to assist in planning, activating, following through clinical investigations, various locations; considerable travel required to assist in successful commercial distribution new drugs; about $15,000 plus agency fee; East. **(b) Pharmacologist;** M.D., Ph.D. to direct basic, clinical, market research department of eight Ph.D.'s; important pharmaceutical company; Midwest. **(c) Associate Biochemist;** Ph.D. qualified to perform research in physical chemistry of proteins; minimum $7000; eastern concern. **(d) Physician;** establish clinical research projects on investigational drugs, supervise to completion and reports; some industrial medicine, 2 to 3 months travel yearly; $13,000 up; East. **(e) Biochemist;** M.S. preferred to supervise eight in department, large medical school affiliated hospital; to $7800; Mideast. **(f) Pharmacologist;** M.D., Ph.D., to direct department of 25; report to research director; to $15,000; important company; East. **(g) M.D. Pharmacologist;** some pharmaceutical experience required; eastern pharmaceutical house. Woodward Medical Bureau, Ann Woodward, Director, 185 North Wabash, Chicago. X

(a) Clinical Research Physician; responsibilities include the evaluation of company data from a medical standpoint on new drugs and the initiation of preliminary as well as extensive clinical studies of new drugs outside the company; some travel, 10 to 25 percent correspondence, professional meetings, writing for technical journals; around $15,000. **(b) Biochemist,** preferably Ph.D., capable of independent work; well-qualified person with master's degree eligible; research project on biochemistry of myocardium; will be given time to conduct own projects; faculty post at university; Midwest; $6000–$8000. **(c) Ph.D.'s in Pharmacology and Biochemistry;** new department, established company; Southwest. **(d) Research Assistant in Pharmacology;** B.S. or M.S., with good technical ability; should be willing to learn usual methods in screening and testing new drugs in animals; duties include developing new radioisotope methods for this purpose; university city, Midwest. S2-3 Medical Bureau, Burneice Larson, Director, 900 N. Michigan, Chicago. X

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Major popular reference work, graduate degree or equivalent in physics or chemistry. Good general background. Editorial experience desirable. Excellent opportunity for person with right background to enter editorial field. Submit full résumé stating salary requirements. Applications should be mailed to: Editor-in-Chief, P. F. Collier Encyclopedia, 640 Fifth Avenue, New York 19, N.Y.

Graduate Research Assistant. Microbiology major; M.S. candidate; strong background in chemistry; $1800, 12 months; free tuition; metropolitan New York area. Box 40, Science. 3/7

POSITIONS OPEN

Instructor or Assistant Professor in Biochemistry Department. Ph.D. or equivalent June or September. Teach medical biochemistry Midwest. Salary open depending upon qualifications. Box 36, SCIENCE. X

Man or Woman with extensive training and working experience in histologic techniques to direct and supervise activities of three to four assistants in microtechnique service laboratory. Salary commensurate with qualifications. Reply to Director, Christ Hospital Institute of Medical Research, 2139 Auburn Avenue, Cincinnati 19, Ohio. 2/21

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College graduate with experience or training in the control of serological and blood coagulation products. Modern laboratory. Good starting salary. Employee benefits. 37½-hour week. Send résumé to

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Professor of Physics, head of department. Good salary, midwestern college with excellent record. Located in small town near metropolitan areas. Ph.D. required. Box 43, SCIENCE. 2/28

Research Assistants with either the master of arts degree or equivalent experience for interesting work in isotope, biology, biochemistry, or clinical laboratories doing cancer research. Graduate instruction available depending upon qualifications. Please submit credentials to Personnel Manager, The University of Texas, M. D. Anderson Hospital & Tumor Institute, Texas Medical Center, Houston, Texas. 2/21

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Zoologist Technician to head zoology and parasitology microtechnique division of commercial laboratory. Advanced degree not required, but thorough experience in paraffin and celloidin methods essential. Preference given to applicant who is presently preparing slides on large scale in commercial or university laboratory. This is a permanent position offering top initial salary and exceptional opportunity for advancement and long-term financial security. Box 16, SCIENCE. 2/7, 21

POSITIONS OPEN

Research Associate. Collaborate with investigators, experimental research in immunologic aspects of cancer. Include details of experience, references. Write Dr. I. Davidsohn, Mount Sinai Medical Research Foundation, 2755 West 15th Street, Chicago, Illinois. 2/7, 14, 21

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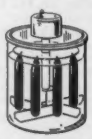

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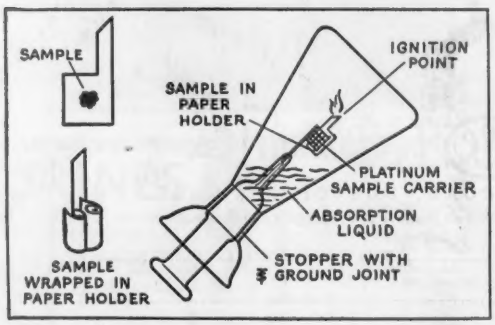
The procedure simply converts organic materials into soluble combustion products, which are then analyzed for chlorine, bromine, iodine, fluorine and sulfur by usual inorganic gravimetric or volumetric methods.

Consisting of a heavy wall, conical flask of borosilicate glass, with deep, bell-shape flaring lip and elongated interchangeable ground glass stopper with attached U-shape platinum wire gauze sample carrier, and small, specially cut, unsized low ash paper sheets which serve as holders for the sample.

In use, the sample is wrapped and folded in the paper with the narrow tail extending for ignition. Sample is then placed in the platinum carrier and the flask is charged with a small amount of absorbing liquid as required for the specific reaction and with free-flowing oxygen. The paper tail is then ignited; the stopper with flaming sample is seated in the flask and flask then inverted at an angle. The catalytic combustion proceeds at high temperatures and the combustion products are absorbed in the liquid, which forms a seal around the stopper. After cooling, the inside surfaces of the flask and stopper are thoroughly rinsed. Titrations can then be made directly in the flask. Due to the inherent fragility of glass in the presence of reduced pressure, general safety regulations should be followed, such as the use of shield, goggles, etc.

Results compare favorably, i.e., within ± 0.3%, with conventional combustion or decomposition methods. The method has been used extensively for analysis of the above elements but, because of the low cost, time and space saving features, should find wide use for materials which undergo complete combustion. The method is useful in research, in educational laboratories and in industrial control.

See Wolfgang Schöniger, "Eine mikroanalytische Schnellbestimmung von Halogen in organischen Substanzen," *Mikrochimica Acta, 1955, Heft 1, pp. 123-129;* and "Die mikroanalytische Schnellbestimmung von Halogenen und Schwefel in organischen Verbindungen," ibid. *1956, Heft 1-6, pp. 869-876.*



6470-E. Combustion Apparatus, Thomas-Schöniger (Schöniger Flask) Micro, as above described, 300 ml capacity, for samples up to 10 mg. With No. 34/28 standard taper stopper and platinum wire gauze sample carrier weighing approximately 1.5 grams, 100 Paper Sample Holders and directions for use **28.35**

6470-G. Ditto, Semimicro. Similar to 6470-E but with 500 ml flask, for samples up to 100 mg..... **29.00**

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